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CONTENTS

Page

1. Geologic Maps, Areal and Regional Geology (including Guidebooks) 1

2. Geomorphology 8

3. Structural Geology 11

4. Stratigraphy and Historical Geology 13

5. Paleontology 16

6. Geophysics 18

7. Geochemistry 22

8. Mineralogy and Crystallography 26

9. Igneous and Metamorphic Petrology 27

10. Sedimentary Petrology 29

11. Geohydrology 31

12. Mineral Deposits (including Geochemical Prospecting) 34

13. Fuels 40

14. Engineering Geology 44

15. Miscellaneous 44

SERIALS

The following list gives in full the abbreviated citations used after the titles of papers in this issue of GeoScience Abstracts.

Akademiya Nauk SSSR, Izvestiya, Seriya Geofizicheskaya; Seriya Geologicheskaya. Moscow-Leningrad.
American Association of Petroleum Geologists, Bulletin. Tulsa, Oklahoma.
American Institute of Mining, Metallurgical and Petroleum Engineers, Petroleum Transactions, Technical Paper. Dallas, Texas.
American Journal of Science. New Haven, Connecticut.
Bulletins of American Paleontology (Paleontological Research Institution). Ithaca, New York.
California Institute of Technology, Division of Geological Sciences, Contribution. Pasadena, California.
Canada, Dept. of Mines and Technical Surveys, Mines Branch, Map. Ottawa.
Canada, Dept. of Mines and Technical Surveys, Surveys and Mapping Branch, [Map]. Ottawa.
Canada, Dept. of Northern Affairs and National Resources, Annual Report. Ottawa.
Canada, Geological Survey, Bulletin; Map; Paper. Ottawa.
Canada, National Museum, Natural History Papers. Ottawa.
Columbia University, Hudson Laboratories, Contribution. Dobbs Ferry, New York.
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Economic Geology (Society of Economic Geologists). Lancaster, Pennsylvania.
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Geochemistry [Geokhimiya]; a translation of the journal of the Academy of Sciences, U.S.S.R., devoted to geochemistry (Geochemical Society). Ann Arbor, Michigan.
Georgia Mineral Newsletter (Georgia, Dept. of Mines, Mining and Geology). Atlanta, Georgia.
Hawaii, Agricultural Experiment Station, Miscellaneous Paper. Honolulu.
Illinois, State Geological Survey, Circular. Urbana, Illinois.
Journal of Geophysical Research. Washington, D. C.
Mineral Industries (Pennsylvania State University, College of Mineral Industries). University Park, Pennsylvania.
Mining Engineering (American Institute of Mining, Metallurgical and Petroleum Engineers). New York.
Montana Bureau of Mines and Geology, Information Circular. Butte, Montana.
National Academy of Sciences-National Research Council, Publication. Washington, D.C.
North American Aviation, Inc., Missile Division, Publication. Downey, California.
Nova Scotia, Dept. of Mines, [Publication]. Halifax.
Oklahoma Geological Survey, Oklahoma Geology Notes. Norman, Oklahoma.
Research Council of Alberta, Contribution. Edmonton, Alberta.
Royal Society of Canada, Transactions, Section 4, Geological Sciences including Mineralogy. Ottawa.
Science. Washington, D.C.
Scientific American. New York.
South Carolina, State Development Board, Division of Geology, Bulletin. Columbia, South Carolina.
Tennessee, Dept. of Conservation, Division of Water Resources, Information Circular. Nashville, Tennessee.
U. S. Atomic Energy Commission, [Publication]. Oak Ridge, Tennessee.
U. S. Geological Survey, Bulletin; Circular; Coal Investigations Map; Geologic Quadrangle Map; Geophysical Investigations Map; Hydrologic Investigations Atlas; Mineral Investigations Map; Miscellaneous Investigations Map; Oil and Gas Investigations Map; Professional Paper; Water-Supply Paper. Washington, D.C.
U. S. Waterways Experiment Station, Vicksburg, Miss., Technical Report.

GeoScience Abstracts

1. GEOLOGIC MAPS, AREAL AND REGIONAL GEOLOGY

PART I. GEOLOGIC MAPS

See also: Geohydrology 1-733.

1-550. Canada, Dept. of Mines and Technical Surveys, Mines Branch. MINERAL MAP OF CANADA: 8th ed., Its Map, no. 900A, scale 1:7,603,200, 1958.

More than 230 mines and 130 oil and gas wells, with names of operating companies, are indexed by province. Routes of Canada's 4 major fuel pipelines are shown. The value of mineral production in 1957 is given by province. --G. E. Denegar.

1-551. Canada, Dept. of Mines and Technical Surveys, Surveys and Mapping Branch. NATURAL RESOURCES: scale 1:6,336,000, 1958.

This colored map shows the locations of producing mines, prospects, mineral occurrences, and fisheries. Both developed water-power supply and undeveloped water-power supply are indicated. Agricultural areas are outlined according to the following classification: mixed farming, including grain and livestock; wheat and other grains; dairying and livestock; and special crops. Forest types are differentiated. Principal rail lines are shown. --G. E. Denegar.

1-552. Stalker, A. MacS. SURFICIAL GEOLOGY, FORT MACLEOD, ALBERTA: Canada, Geol. Survey, Map 21-1958, scale 1 in. to 4 mi., marginal notes, 1959.

Preliminary-series map of an area in southern Alberta showing the distribution of the glacial and post-glacial deposits. Most of the area is covered by deposits left by the Laurentide ice and in it are many deposits attributable to the cordilleran glaciers which advanced into the plains from the mountains to the SW. Much of the area was at one time or another covered by lakes impounded by the ice, and fine-grained material laid down in these [lakes], can be seen in many places. In a few places along the line marking the limits of the 2 ice sheets, pre-Wisconsin tills are preserved. --H. M. A. Rice.

1-553. Riley, G. C. CUMBERLAND SOUND, NORTHWEST TERRITORIES: Canada, Geol. Survey, Map 1061A, scale 1:506,880, marginal notes, 1959.

Geological map of a strip some 20 mi. wide around the shore of Cumberland Sound on the SW. coast of Baffin Island. The area is underlain almost entirely by Precambrian granite gneisses and granitic rocks. They can be divided into various mineralogical types, but the relative ages of these is unknown. --H. M. A. Rice.

1-554. Cass, J. T. RECONNAISSANCE GEOLOGIC MAP OF THE KATEEL RIVER QUADRANGLE, ALASKA: U. S. Geol. Survey, Misc. Inv. Map I-243, scale 1:250,000, lat. 65°-66°N., long. 156°-159°W., 1957, pub. 1958.

The map, on a topographic quadrangle base, covers an area of about 6,200 sq. mi. in the Koyukuk Cretaceous basin in W.-central Alaska. Thick sequences of sedimentary and igneous rocks, which are largely Cretaceous and Tertiary in age, are shown. Data used in compiling the map were derived largely from the study of aerial photographs, supplemented by field work, and from out-of-print publications of the U. S. Geological Survey. --U. S. Geol. Survey.

1-555. Péwé, T. L. GEOLOGY OF THE FAIRBANKS (D-2) QUADRANGLE, ALASKA: U. S. Geol. Survey, Geol. Quad. Map GQ-110, scale 1:63,360, contour interval 50 ft., lat. 64°45'-65°N., long. 147°30'-148°W., 1958.

The map shows the geology of an area of about 250 sq. mi. in central Alaska. Five units of bedrock and 7 units of unconsolidated material are shown in color. Much of the ground in this area is perennially frozen. The engineering geologic problems associated with permafrost are outlined in the text and in tables describing the physical properties of the map units. --U. S. Geol. Survey.

1-556. Andreasen, G. E., W. J. Dempsey, John R. Henderson, Jr., and F. P. Gilbert. AEROMAGNETIC MAP OF THE COPPER RIVER BASIN, ALASKA: U. S. Geol. Survey, Geophys. Inv. Map GP-156, scale 1:125,000, contour intervals 20 and 100 gammas, lat. 61°45'-63°N., long. 145°-147°30'W., 1958.

1-557. Dibblee, Thomas W., Jr. GEOLOGIC MAP OF THE CASTLE BUTTE QUADRANGLE, KERN COUNTY, CALIF.: U. S. Geol. Survey, Mineral Inv. Map MF-170, scale 1:62,500, contour interval 25 ft., lat. 35°-35°15'N., long. 117°45'-118°W., 1958.

1-558. McGill, J. T. PRELIMINARY MAP OF LANDSLIDES IN THE PACIFIC PALISADES AREA, CITY OF LOS ANGELES, CALIF: U. S. Geol. Survey, Misc. Inv. Map I-284, scale 1:4,800, contour interval 5 ft., 1959.

1-559. Radbruch, D. H., and Julius Schlocker. ENGINEERING GEOLOGY OF ISLAIS CREEK BASIN, SAN FRANCISCO, CALIF.: U. S. Geol. Survey, Misc. Inv. Map I-264, scale 1:12,000, contour interval 25 ft., lat. 37°43'45"-37°45'45"N., long. 122°22'30"-122°25'W., 1958.

Sediments overlying bedrock in the Islais Creek basin consist of older bay clay, a sand layer, younger bay mud and clay, and artificial fill. The extent, surface configuration, and thickness of these units, and surface configuration of bedrock surrounding or underlying the basin are shown on maps and diagrams. A brief text discusses physical characteristics and geologic history of the sediments. --U. S. Geol. Survey.

1-560. Johnson, R. B., G. H. Wood, Jr., and R. L. Harbour. PRELIMINARY GEOLOGIC MAP OF THE NORTHERN PART OF THE RATON MESA REGION AND HUERFANO PARK IN PARTS OF LAS ANIMAS, HUERFANO, AND CUSTER COUNTIES, COLO.: U. S. Geol. Survey, Oil & Gas Inv. Map OM-183, 2 sheets, scale 1:63,360, columnar sec., 1958.

About 1,800 sq. mi. of S.-central Colorado are shown on this map, which combines data from several previously published maps and shows the geology of part of the Raton basin, Sangre de Cristo Mountains, and the dike systems of Spanish Peaks and Dike Mountain. The stratigraphy of Paleozoic, Mesozoic, and Cenozoic rocks is shown on a generalized columnar section. The map data presented will aid exploration for petroleum in the Raton basin. --U. S. Geol. Survey.

1-561. Sheridan, D. M., C. H. Maxwell, A. L. Albee, and Richard Van Horn. PRELIMINARY MAP OF BEDROCK GEOLOGY OF THE RALSTON BUTTES QUADRANGLE, JEFFERSON COUNTY, COLO.: U. S. Geol. Survey, Mineral Inv. Map MF-179, scale 1:24,000, contour interval 50 ft., lat. 39°45'-39°52'30"N., long. 105°15'-105°22'30"W., 1958.

This area of 58 sq. mi. on the eastern flank of the Colorado Front Range is underlain predominantly by Precambrian metamorphic and igneous rocks. These rocks and the overlying Paleozoic and Mesozoic sedimentary rocks are cut by northwestward-trending faults and fracture zones of Laramide age. Pitchblende-bearing hydrothermal veins occupy openings in fault breccias and related fractures. Two index maps and a brief text of economic geology are included. --U. S. Geol. Survey.

1-562. Osterwald, F. W., and B. G. Dean, comps. PRELIMINARY TECTONIC MAP OF NORTHERN COLORADO AND NORTHEASTERN UTAH, SHOWING THE DISTRIBUTION OF URANIUM DEPOSITS: U. S. Geol. Survey, Mineral Inv. Map MF-130, 2 sheets, scale 1:500,000, 1958.

1-563. Simpson, H. E. NEW BRITAIN, CONN. SURFICIAL GEOLOGY: U. S. Geol. Survey, Geol. Quad. Map GQ-119, scale 1:24,000, contour interval 10 ft., lat. 41°37'30"-41°45'N., long. 72°45'-72°52'30"W., 1959.

This quadrangle covers about 56 sq. mi. in central Connecticut. The area is mantled chiefly by surficial deposits left by late Wisconsin glaciation and in part by Recent deposits. Distribution of the various kinds of materials including sand and gravel, clay, peat, artificial fill, and till is shown, together with the distribution of bedrock exposures. Some information regarding the thickness of the surficial mantle is given. --U. S. Geol. Survey.

1-564. Castle, R. O. SURFICIAL GEOLOGY OF THE LAWRENCE QUADRANGLE, MASS.-N.H.: U. S. Geol. Survey, Geol. Quad. Map GP-107, scale 1:31,680, contour interval 10 ft., lat. 42°37'30"-42°45'N., long. 71°07'30"-71°15'W., 1958.

More than 90% of the Lawrence quadrangle is covered by glacial deposits of Wisconsin age. Outwash sequences composed mostly of ice-contact forms occupy pre-Wisconsin, possibly preglacial, valleys. Till covers upland areas and includes ground moraine and drumlins. The Merrimack River follows a post-glacial channel across the area. Scattered areas of bedrock outcrops are shown. --U. S. Geol. Survey.

1-565. Herz, Norman. BEDROCK GEOLOGY OF THE CHESHIRE QUADRANGLE, MASS.: U. S. Geol. Survey, Geol. Quad. Map GQ-108, scale 1:31,680, contour intervals 10 and 20 ft., lat. 42°30'-42°37'30"N., long. 73°07'30"-73°15'W., 1958.

Structures in this region are both Green Mountain and Taconic Range in type. The Green Mountain consists of hills with cores of Precambrian gneiss and is overlain by rocks of Early Cambrian age, overturned toward the W., and cut by thrust faults. The Taconic Range has tightly folded and overturned synclinal ridges of schist and anticlinal valleys of marble. The Berkshire schist transgresses all older formations and may represent a major unconformity in the lower part of the Middle Ordovician. --U. S. Geol. Survey.

1-566. Beikman, H. M., and Sophie Drakoulis. MAP OF MISSISSIPPI SHOWING OIL AND GAS FIELDS, UNSUCCESSFUL TEST WELLS, SALT DOMES, AND PIPELINES: U. S. Geol. Survey, Oil & Gas Inv. Map OM-200, scale 1:500,000, secs., 1958.

This map shows locations of most of the unsuccessful test wells drilled for oil and gas in Mississippi, total depth of most of the important test wells drilled in the State as of Sept. 1957, and the locations of known salt domes and of oil and gas pipelines. Included are composite stratigraphic sections showing rocks that have been penetrated by drilling, lists of oil and gas fields and salt domes, and a brief text. --U. S. Geol. Survey.

1-567. Osterwald, F. W., and B. G. Dean, comps. PRELIMINARY TECTONIC MAP OF EASTERN MONTANA SHOWING THE DISTRIBUTION OF URANIUM DEPOSITS: U. S. Geol. Survey, Mineral Inv. Map MF-126, 2 sheets, scale 1:500,000, 1958.

1-568. Reed, E. C., R. F. Svoboda, G. E. Prichard, and Jeannette Fox. MAP OF NEBRASKA SHOWING AREAL DISTRIBUTION OF PRE-PENNSYLVANIAN ROCKS, ANTICLINES AND BASINS, OIL AND GAS FIELDS, PIPELINES AND UNSUCCESSFUL TEST WELLS: U. S. Geol. Survey, Oil & Gas Inv. Map OM-198, scale 1:500,000, 1958.

Total depths of wells and the age of the oldest formation penetrated by each well are given. Included is a list of oil and gas fields in Banner, Cheyenne, and Kimball counties. Producing formations in each field are also named. Well data were compiled as of Sept. 1, 1957. --U. S. Geol. Survey.

1-569. Osterwald, F. W., and B. G. Dean, comps. PRELIMINARY TECTONIC MAP OF WESTERN NEBRASKA AND NORTHWESTERN KANSAS SHOWING THE DISTRIBUTION OF URANIUM DEPOSITS: U. S. Geol. Survey, Mineral Inv. Map MF-129, 2 sheets, scale 1:500,000, 1958.

1-570. Bowyer, Ben, E. H. Pampeyan, and C. R. Longwell. GEOLOGIC MAP OF CLARK COUNTY, NEV.: U. S. Geol. Survey, Mineral Inv. Map MF-138, scale 1:200,000, contour interval 500 ft., 1958.

1-571. Park, C. F., Jr., Paul Gemmill, and C. M. Tschanz. GEOLOGIC MAP AND SECTIONS OF THE PIOCHE HILLS, LINCOLN COUNTY, NEV.: U. S. Geol. Survey, Mineral Inv. Map MF-136, scale 1:12,000, contour interval 25 ft., 1958.

1-572. Henderson, John R., Jr., Natalie S. Tyson, Sybil A. Gilchrist, and others. AEROMAGNETIC MAP OF THE BERNARDSVILLE AND PART OF THE BOUND BROOK QUADRANGLES, MIDDLESEX, SOMERSET, AND MORRIS COUNTIES, N. J.: U. S. Geol. Survey, Geophys. Inv. Map GP-174, scale

1:31,680, contour intervals 50 and 250 gammas, lat. 40°32'30"-40°45'N., long. 74°30'-74°37'30"W., 1958.

1-573. Henderson, John R., Jr., Natalie S. Tyson, Sybil A. Gilchrist, and others. AEROMAGNETIC MAP OF THE CHATHAM AND PARTS OF THE ROSELLE AND PLAINFIELD QUADRANGLES, MORRIS, UNION, ESSEX, AND SOMERSET COUNTIES, N. J.: U. S. Geol. Survey, Inv. Map GP-175, scale 1:31,680, contour intervals 50 and 100 gammas, lat. 40°37'30"-40°45'N., long. 74°15'-74°30'W., 1958.

1-574. Buckwalter, T. V. GEOLOGY OF THE PRECAMBRIAN ROCKS AND HARDYSTON FORMATION OF THE BOYERTOWN QUADRANGLE: Pennsylvania Geol. Survey, 4th ser., Atlas 197, scale 1:24,000, accompanying text, 1959.

This report describes a geologic survey of the crystalline rocks and Hardyston formation in the Boyertown quadrangle in Berks County, Pennsylvania. This survey is part of a broader program which will eventually result in a comprehensive report of the geology of Berks County. The present report includes chiefly a geologic map of the area and descriptions, megascopic and in part petrographic, of the formations encountered. --Auth.

1-575. Wood, G. H., Jr., J. Peter Trexler, Andy Yelenosky, and Julian Soren. GEOLOGY OF THE NORTHERN HALF OF THE MINERSVILLE QUADRANGLE AND A PART OF THE NORTHERN HALF OF THE TREMONT QUADRANGLE, SCHUYLKILL COUNTY, PA.: U. S. Geol. Survey, Coal Inv. Map C-43, 2 sheets: sheet 1, map, scale 1:12,000, contour interval 20 ft., lat. 40°41'15"-40°45'N., long. 76°15'-76°22'30"W.; sheet 2, struct. cross-secs., 1958.

Sheet 1 includes (1) a geologic map which shows surface distribution of Mississippian and Pennsylvanian rocks, principal coal beds, and locations of mine slopes, shafts, and prospect pits, (2) table of Pennsylvanian and Mississippian floral zones, (3) 2 index maps locating anthracite fields in Pennsylvania, and (4) brief description of general geology. Sheet 2 includes 12 structural cross-sections, one composite stratigraphic section showing nature and thicknesses of strata, and 3 diagrammatic sections showing stratigraphic relations of the rocks. --U.S. Geol. Survey.

1-576. Brobst, Donald A. PRELIMINARY GEOLOGIC MAP OF THE NORTHEAST PART OF THE DEWEY QUADRANGLE, CUSTER COUNTY, S. DAK., AND WESTON COUNTY, WYO.: U. S. Geol. Survey, Mineral Inv. Map MF-77, scale 1:7,200, contour interval 20 ft., 1958.

1-577. Brobst, Donald A. PRELIMINARY GEOLOGIC MAP OF THE EAST-CENTRAL PART OF THE DEWEY QUADRANGLE, CUSTER COUNTY, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-78, scale 1:7,200, contour interval 20 ft., 1958.

1-578. Schnabel, R. W., and L. F. Charlesworth, Jr. PRELIMINARY GEOLOGIC MAP OF THE NORTHEAST PART OF THE BURDOCK QUADRANGLE, FALL RIVER AND CUSTER COUNTIES, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-72, scale 1:7,200, contour interval 10 ft., 1958.

1-579. Schnabel, R. W., and L. J. Charlesworth, Jr. PRELIMINARY GEOLOGIC MAP OF THE NORTHWEST PART OF THE BURDOCK QUADRANGLE, FALL RIVER AND CUSTER COUNTIES, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-73, scale 1:7,200, contour interval 10 ft., 1958.

1-580. Schnabel, R. W. PRELIMINARY GEOLOGIC MAP OF THE EAST-CENTRAL PART OF THE BURDOCK QUADRANGLE, FALL RIVER COUNTY, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-74, scale 1:7,200, contour interval 20 ft., 1958.

1-581. Schnabel, R. W., and L. J. Charlesworth, Jr. PRELIMINARY GEOLOGIC MAP OF THE WEST-CENTRAL PART OF THE BURDOCK QUADRANGLE, FALL RIVER COUNTY, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-71, scale 1:7,200, contour interval 10 ft., 1958.

1-582. Schnabel, R. W., and L. J. Charlesworth, Jr. PRELIMINARY GEOLOGIC MAP OF THE SOUTHEAST PART OF THE BURDOCK QUADRANGLE, FALL RIVER AND CUSTER COUNTIES, S. DAK.: U. S. Geol. Survey, Mineral Inv. Map MF-75, scale 1:7,200, contour interval 10 ft., 1958.

1-583. Englund, K. J. GEOLOGY AND COAL RESOURCES OF THE IVYDELL QUADRANGLE, CAMPBELL COUNTY, TENN.: U. S. Geol. Survey, Coal Inv. Map C-40, scale 1:24,000, contour interval 20 ft., lat. 36°22'30"-36°30'N., long. 84°07'30"-84°15"W., 1958.

About 60 sq. mi. in the northern part of the Tennessee coal field are shown on this map, which includes geologic boundaries, coal-bed outcrops and core-hole locations, rock formations ranging from Ordovician to Pennsylvanian, and structure contour lines and anticlinal and synclinal axes. Stratigraphic sections (scale 1 in. = 50 ft.) and a structural cross-section are also included. A brief text describes the geology and oil and gas possibilities. --U. S. Geol. Survey.

1-584. Carswell, L. D., E. S. Davidson, and G. A. Miller. PRELIMINARY GEOLOGIC MAP OF THE CIRCLE CLIFFS 1 SW QUADRANGLE, GARFIELD COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-155, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 111°07'30"-111°15'W., 1958.

1-585. Davidson, E. S., D. A. Brew, and L. D. Carswell. CIRCLE CLIFFS 1 SE QUADRANGLE, GARFIELD COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-156, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 111°-111°07'30"W., 1958.

1-586. Davidson, E. S., D. A. Brew, and L. D. Carswell. PRELIMINARY GEOLOGIC MAP OF

THE CIRCLE CLIFFS 4 NE QUADRANGLE, GARFIELD COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-158, scale 1:24,000, contour interval 40 ft., lat. 37°37'30"-37°45'N., long. 111°-111°07'30"W., 1958.

1-587. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 2 NE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-190, scale 1:24,000, contour interval 40 ft., lat. 37°52'30"-38°N., long. 109°45'-109°52'30"W., 1958, pub. 1959.

1-588. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 1 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-201, scale 1:24,000, contour interval 40 ft., lat. 37°52'30"-38°N., long. 109°37'30"-109°45'W., 1958, pub. 1959.

1-589. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 2 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-191, scale 1:24,000, contour interval 40 ft., lat. 37°52'30"-38°N., long. 109°52'30"-110°W., 1958, pub. 1959.

1-590. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 2 SE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-193, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 109°45'-109°52'30"W., 1958, pub. 1959.

1-591. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 2 SW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-192, scale 1:24,000, contour interval 40 ft., lat. 37°45'-37°52'30"N., long. 109°52'30"-110°W., 1958, pub. 1959.

1-592. Lewis, R. Q., Sr., and R. H. Campbell. PRELIMINARY GEOLOGIC MAP OF THE ELK RIDGE 3 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-195, scale 1:24,000, contour interval 40 ft., lat. 37°37'30"-37°45'N., long. 109°52'30"-110°W., 1958, pub. 1959.

1-593. Hemphill, W. R. MOUNT ELLEN-5 QUADRANGLE, WAYNE COUNTY, UTAH: U. S. Geol. Survey, Misc. Inv. Map I-250, photogeologic map, scale 1:24,000, lat. 38°15'-38°22'30"N., long. 110°52'30"-111°W., 1958.

1-594. Carter, W. D., J. L. Gualtieri, and E. M. Shoemaker. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 1 NE QUADRANGLE, SAN JUAN COUNTY, UTAH, AND MONTROSE COUNTY, COLO.: U. S. Geol. Survey, Mineral Inv. Map MF-139, scale 1:24,000, contour interval 40 ft., lat. 38°22'30"-38°30'N., long. 109°-109°07'30"W., 1958.

1-595. Carter, W. D., and J. L. Gualtieri. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 1 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-140, scale 1:24,000, contour interval 40 ft., lat. 38°22'30"-38°30'N., long. 109°07'30"-109°15'W., 2 cross-secs., 1958.

The structure and distribution of sedimentary rocks that range in age from Pennsylvanian to Cretaceous are shown. Units of the Morrison formation are differentiated because they contain U-V deposits in adjacent areas. Two geologic cross-sections show the average formational thickness and salient structural features.--U. S. Geol. Survey.

1-596. Weir, G. W., and N. C. Kennedy. MOUNT PEALE 2 SW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-142, scale 1:24,000, contour interval 40 ft., lat. 38°15'-38°22'30"N., long. 109°22'30"-109°30'W., 1958.

1-597. Weir, G. W., and C. L. Dodson. MOUNT PEALE 3 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-144, scale 1:24,000, contour interval 40 ft., lat. 38°07'30"-38°15'N., long. 109°22'30"-109°30"W., 1958.

1-598. Weir, G. W., and C. L. Dodson. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 3 SE QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-147, scale 1:24,000, contour interval 40 ft., lat. 38°-38°07'30"N., long. 109°15'-109°22'30"W., 1958.

1-599. Weir, G. W., and C. L. Dodson. MOUNT PEALE 3 SW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-146, scale 1:24,000, contour interval 40 ft., lat. 38°-38°07'30"N., long. 109°22'30"-109°30'W., 1958.

1-600. Weir, G. W., and C. L. Dodson. PRELIMINARY GEOLOGIC MAP OF THE MOUNT PEALE 4 SW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-148, scale 1:24,000, contour interval 40 ft., lat. 38°-38°07'30"N., long. 109°07'30"-109°15'W., 1958.

1-601. McKeown, F. A., C. C. Hawley, and P. O. Orkild. PRELIMINARY GEOLOGIC MAP OF THE ORANGE CLIFFS 3 NE QUADRANGLE, WAYNE AND GARFIELD COUNTIES, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-173, scale 1:24,000, contour interval 40 ft., lat. 38°07'30"-38°15'N., long. 110°15'-110°22'30"W., 1958.

1-602. Witkind, I. J. VERDURE 2 NW QUADRANGLE, SAN JUAN COUNTY, UTAH: U. S. Geol. Survey, Mineral Inv. Map MF-162, scale 1:24,000, contour interval 40 ft., lat. 37°52'30"-38°N., long. 109°22'30"-109°30'W., 1958.

1-603. Pomeroy, J. S. PHOTOGEOLOGIC MAP OF THE JOHNSON NW QUADRANGLE, KANE

COUNTY, UTAH: U. S. Geol. Survey, Misc. Inv. Map I-267, scale 1:24,000, lat. 37°07'30"-37°15'N., long. 112°22'30"-112°30'W., 1958.

1-604. McQueen, Kathleen. PARIA NE QUADRANGLE, KANE COUNTY, UTAH: U. S. Geol. Survey, Misc. Inv. Map I-266, photogeologic map, scale 1:24,000, lat. 37°07'30"-37°15'N., long. 111°45'-111°52'30"W., 1958.

1-605. McQueen, Kathleen, and R. G. Ray. PHOTOGEOLOGIC MAP OF THE PARIA NW QUADRANGLE, KANE COUNTY, UTAH: U. S. Geol. Survey, Misc. Inv. Map I-268, scale 1:24,000, lat. 37°07'30"-37°15'N., long. 111° 52'30"-112°W., 1958.

1-606. McQueen, Kathleen. PARIA SE QUADRANGLE, KANE COUNTY, UTAH, AND COCONINO COUNTY, ARIZ.: U. S. Geol. Survey, Misc. Inv. Map I-265, photogeologic map, scale 1:24,000, lat. 37°-37°07'30"N., long. 111°45'-111°52'30"W., 1958.

1-607. Harris, L. D., and R. L. Miller. GEOLOGY OF THE DUFFIELD QUADRANGLE, VA.: U. S. Geol. Survey, Geol. Quad. Map GQ-111, scale 1:24,000, contour interval 20 ft., lat. 36°37'30"-36°45'N., long. 82°45'-82°52'30"W., 1958.

The Duffield quadrangle covers about 60 sq. mi. in eastern Lee County and northwestern Scott County, Va. About 13,000 ft. of bedrock, ranging in age from Cambrian to Mississippian, is exposed along a series of northeastward-trending asymmetrical folds and thrust faults.--U. S. Geol. Survey.

1-608. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. ABERDEEN QUADRANGLE, GRAYS HARBOR AND PACIFIC COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-177, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-47°N., long. 123°45'-124°W., 1958.

1-609. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. ADNA QUADRANGLE, LEWIS COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-187, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 123°-123°15'W., 1958.

1-610. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. CAPE SHOALWATER QUADRANGLE, PACIFIC COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-183, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 124°-124°15'W., 1958.

1-611. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. CENTRALIA QUADRANGLE, LEWIS COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-188, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 122°45'-123°W., 1958.

1-612. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. GRAYLAND QUADRANGLE, GRAYS HARBOR AND PACIFIC COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-176, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-47°N., long. 124°-124°15'W., 1958.

1-613. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. MALONE QUADRANGLE, GRAYS HARBOR, PACIFIC, AND LEWIS COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-179, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-47°N., long. 123°15'-123°30'W., 1958.

1-614. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. MONTESANO QUADRANGLE, GRAYS HARBOR AND PACIFIC COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-178, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-47°N., long. 123°30'-123°45'W., 1958.

1-615. Henderson, John R., Jr., Natalie S. Tyson, Sybil A. Gilchrist, and others. ONALASKA QUADRANGLE, LEWIS COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-189, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 122°30'-122°45'W., 1958.

1-616. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. PE ELL QUADRANGLE, PACIFIC AND LEWIS COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-186, scale 1:62,500, contour intervals 50 and 250 gammas, lat. 46°30'-46°45'N., long. 123°15'-123°30'W., 1958.

1-617. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. ROCHESTER QUADRANGLE, THURSTON, GRAYS HARBOR, AND LEWIS COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-180, scale 1:62,500, contour intervals 50 and 100 gammas, lat. 46°45'-47°N., long. 123°-123°15'W., 1958.

1-618. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. SOUTH BEND QUADRANGLE, PACIFIC COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-184, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 123°45'-124°W., 1958.

1-619. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. TENINO QUADRANGLE, THURSTON AND LEWIS COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-181, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-47°N., long. 122°45'-123°W., 1958.

1-620. Henderson, John R., Jr., Natalie S. Tyson, E. F. McGowan, and others. WILLAPA QUADRANGLE, PACIFIC COUNTY, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-185, scale 1:62,500, contour interval 50 gammas, lat. 46°30'-46°45'N., long. 123°30'-123°45'W., 1958.

1-621. Henderson, John R., Jr., Natalie S. Tyson, Sybil A. Gilchrist, and others. PART OF THE YELM QUADRANGLE, THURSTON AND LEWIS COUNTIES, WASH.: U. S. Geol. Survey, Geophys. Inv. Map GP-182, scale 1:62,500, contour interval 50 gammas, lat. 46°45'-46°55'N., long. 122°30'-122°45'W., 1958.

1-622. Rau, W. W. STRATIGRAPHY AND FORAMINIFERAL ZONATION IN SOME OF THE TERTIARY ROCKS OF SOUTHWESTERN WASHINGTON: U. S. Geol. Survey, Oil & Gas Inv. Map OC-57, 2 sheets, 1958.

More than 200 species of Foraminifera from 13 measured surface and subsurface sections (vertical scale, 1 in. = 300 ft.) are used as a basis for dividing rocks of Eocene, Oligocene, and Miocene age into 7 zones. The fossils from each zone are compared with known faunas, and correlations of these zones with recognized time divisions of the Tertiary sequence of the Pacific coast are suggested. A short text discusses the faunal characteristics of each zone.--U. S. Geol. Survey.

1-623. Yates, R. G., and J. F. Robertson. LEADPOINT QUADRANGLE, STEVENS COUNTY, WASH.: U. S. Geol. Survey, Mineral Inv. Map MF-137, scale 1:24,000, contour interval 40 ft., lat. 48°52'30"-49°N., long. 117°30'-117°37'30"W., 1958.

Leadpoint quadrangle is an area of mildly metamorphosed lower Paleozoic sedimentary rocks, intruded by igneous rocks of Mesozoic and Tertiary age. The sedimentary rocks are compressed into northeastward-trending folds and are broken by high-angle faults. Many of the Pb-Zn deposits of the Northport mining district are within the mapped area. --U. S. Geol. Survey.

1-624. Osterwald, F. W., and B. G. Dean, comps. PRELIMINARY TECTONIC MAP OF WYOMING EAST OF THE OVERTHRUST BELT, SHOWING THE DISTRIBUTION OF URANIUM DEPOSITS: U. S. Geol. Survey, Mineral Inv. Map MF-127, scale 1:500,000, 1958.

1-625. Finnell, Tommy L., and I. S. Parrish. URANIUM DEPOSITS AND PRINCIPAL ORE-BEARING FORMATIONS OF THE CENTRAL CORDILLERAN FORELAND REGION: U. S. Geol. Survey, Mineral Inv. Map MF-120, 2 sheets: sheet 1, map, scale 1:750,000; sheet 2, table and text, 1958.

U deposits are shown for most of Wyoming and parts of adjacent States, an increasingly important source area of U in the United States. Although U deposits occur in at least 34 formations, most ore deposits occur in 9 formations. A text discusses history of production, mineralogy, structural associations, distribution of main host rocks, and host-rock lithology of the principal deposits. -- U. S. Geol. Survey.

1-626. Brown, G. F., and others. ARABIAN PENINSULA: U. S. Geol. Survey, Misc. Inv. Map I-270 B-1, scale 1:2,000,000, 1958.

1-627. Brown, G. F., and R. O. Jackson. GEOGRAPHIC MAP OF THE ASIR QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-217 B, scale 1:500,000, lat. 16°-20°N., long. 42°-45°E., 1958.

1-628. Brown, G. F., and R. O. Jackson. GEOGRAPHIC MAP OF THE TIHAMAT ASH SHAM QUADRANGLE, KINGDOM OF SAUDI ARABIA: U. S. Geol. Survey, Misc. Inv. Map I-216 B, scale 1:500,000, lat. 16°-20°N., long. 39°-42°E., 1958.

PART 2. AREAL AND REGIONAL GEOLOGY

See also: Geomorphology 1-641; Geohydrology 1-740; Mineral Deposits 1-748, 1-760; Fuels 1-769, 1-774, 1-777; Engineering Geology 1-779.

1-629. Taylor, F. C. SHETHANEI LAKE, MANITOBA: Canada, Geol. Survey, Paper 58-7, 11 p., illus., Map 15-1958 (in pocket), scale 1 in. to 4 mi., 1958, 5 refs.

Preliminary report on a 5,000 sq. mi. area of the Canadian Shield in northern Manitoba. Over most of the area drift is heavy and outcrops scarce. Where bedrock can be seen it consists of granitic rocks and gneisses and schists interlayered with only slightly less abundant, older, mainly arenaceous sediments. Associated with the latter are minor amounts of andesite and basalt. In the NE. corner of the area is a basin of younger Precambrian sediments comprising arenaceous and argillaceous rocks and some dolomite. Known occurrences of ore minerals are confined to the latter rocks.--H. M. A. Rice.

1-630. Snyder, G. L. GEOLOGY OF LITTLE SITKIN ISLAND, ALASKA: U. S. Geol. Survey, Bull. 1028-H (Investigations of Alaskan Volcanoes), p. 169-210, 8 illus., geol. map (in pocket), scale 1:20,000, 4 tables, Feb. 1959, 31 refs.

Little Sitkin Island, in the Rat Islands group of the Aleutian Islands, is composed of extrusive igneous rocks ranging in age from Late Tertiary(?) to Recent. The youngest rocks are about half a century old. The island is in a calcic petrographic province and has an alkali-lime index of 63.5. Composition of lavas and pyroclastic debris ranges from basalt to rhyodacite, but most rocks are andesite, bandaite, or dacite. Three main periods of volcanism were separated by periods of caldera formation. Lavas and pyroclastic debris of the first volcanic period were dominantly andesite and originally constituted 78% by weight of all extrusive rocks on Little Sitkin. Lavas of the second period were high-silica dacite containing many andesite intrusions and originally constituted 17% by weight of all extrusive rocks on Little Sitkin. Lavas of the last, and presently active, period are low-silica dacite that now constitutes 4% by weight of all extrusive rocks on Little Sitkin. Minor amounts of dacite and andesitic pyroclastic debris are ejected during or following each caldera-forming episode.

Considerable heterogeneity of magma type characterizes each extrusive epoch. Lavas from the same or adjacent vents differ markedly in composition. In one case, rhyodacite and low-silica dacite were extruded simultaneously as a lava flow from the same vent. Similar phenomena are recorded in layered inhomogeneous volcanic bombs. The lack of local compositional pattern contrasts markedly with the overall chemical interrelationships of the suite of rocks on Little Sitkin Island. All oxide constituents of 12 to 13 chemical analyses have a remarkably rectilinear relationship with each other when plotted against SiO_2 on a variation diagram. The best explanation of the volumetric, temporal, and compositional relationships of lavas of Little Sitkin is believed to be as follows: tectonic kneading in the Aleutian welt has mechanically mixed portions of continental and oceanic rock; subsequently magmatic melts, which are local in both space and time, have developed in this mixed zone and penetrated to the surface.--Auth.

1-631. Freeman, V. L., E. T. Ruppel, and M. R. Klepper. **GEOLOGY OF PART OF THE TOWNSEND VALLEY, BROADWATER AND JEFFERSON COUNTIES, MONTANA:** U. S. Geol. Survey, Bull. 1042-N, p. 481-556, 5 illus., geol. map (in pocket), scale 1:48,000, table, 1958, pub. Jan. 1959, 46 refs.

The Townsend Valley, a broad intermontane basin in W.-central Montana, extends from Toston to Canyon Ferry. The area described in this report includes that part of the valley W. of long. 111°30'W. and S. of lat. 46°30'N. and the low hills W. and S. of the valley. The Missouri River enters the area near Townsend and flows northward through the northern half of the area. Three perennial tributaries and a number of intermittent streams flow across the area and into the river from the W.

The hilly parts of the area are underlain mainly by folded sedimentary rocks ranging in age from Precambrian to Cretaceous. The broad pediment in the southwestern part is underlain mainly by folded andesitic volcanic rocks of Upper Cretaceous age and a relatively thin sequence of gently deformed tuffaceous rocks of Tertiary age. The remainder of the area is underlain by a thick sequence of Tertiary tuffaceous rocks that is partly blanketed by late Tertiary and Quaternary unconsolidated deposits. Two units of Precambrian age, 13 of Paleozoic age, 7 of Mesozoic age, and several of Cenozoic tuffaceous rock and gravel were mapped.

Rocks of the Belt series of Precambrian age comprise a thick sequence of siltstone, sandstone, shale, and subordinate limestone divisible into the Greyson shale, the Spokane shale, and the basal part of the Empire shale, which was mapped with the underlying Spokane shale.

The Precambrian rocks are overlain with slight angular unconformity by a parallel-bedded sequence of Paleozoic and Mesozoic sedimentary rocks. The formations of Cambrian age, named from oldest to youngest, are the Flathead quartzite, Wolsey shale, Meagher limestone, and Park shale of Middle Cambrian age, and the Pilgrim dolomite of Late Cambrian age. The uppermost Cambrian unit, the Red Lion formation, and the basal Devonian unit, the Maywood formation of Late Devonian age, are thin units that are difficult to distinguish from one another, and accordingly they were mapped together even though they are separated by an erosional unconformity. The Maywood formation is overlain by the Jefferson dolomite of Devonian age, and the Three Forks shale of Devonian and Mississippian age, and these are overlain by the Lodgepole and Mission Canyon limestones, subdivisions of the Madison group of Mississippian age. The Amsden formation, which is probably separated from the Mission Canyon limestone by an erosional unconformity of negligible relief, includes rocks of both Mississippian and Pennsylvanian age. It consists of red calcareous siltstone with a medial unit of gray carbonate rock and grades into the Quadrant formation of Pennsylvanian age, which consists of interbedded dolomite and quartzite. The Phosphoria formation of Permian age overlies the Quadrant formation and in most places has been mapped with it. The formation, consisting dominantly of chert and quartzite, contains phosphate rock in the southern part of the map area, but farther N. phosphatic material is present only as chips and pellets.

Upper Jurassic rocks rest on an erosion surface of very slight relief developed on the Phosphoria formation and grade upward into Lower Cretaceous rocks. The Jurassic rocks comprise the thin marine Swift formation and the relatively thick nonmarine Morrison formation. The Cretaceous sequence consists of the nonmarine Kootenai formation; the Colorado formation, comprising a lower unit of black shale with a basal sandstone, a medial unit of sandstone and siliceous shale, and an upper unit of black shale; the Slim Sam formation, consisting largely of andesitic sandstone; and the Elkhorn Mountains volcanics. In the map area, the Elkhorn Mountains volcanics are unconformable on the Slim Sam formation and older rocks, but along the E. front of the Elkhorn Mountains several miles to the NW. the Slim Sam formation grades into the volcanics.

The rocks of Tertiary age are mainly sedimentary tuffs of acidic composition. In the northern part of the area, one unit of Oligocene age, one of probable Oligocene age, one of Miocene or Pliocene age, and one of uncertain age were mapped. In the southern part of the area, all Tertiary rocks are probably of Oligocene age, but the absence of good exposures made it impracticable to subdivide them. The Oligocene rocks were deposited largely in a lacustrine environment, and Miocene or Pliocene rocks were deposited mainly in a fluviatile environment. The oldest sedimentary tuff, comprising a lower rhyolitic part and an upper bentonitic part, is overlain by a unit composed of bentonitic clays, coarser volcanic debris of probable local origin, and common thin beds of silt, sand, and gravel. The unit of probable Oligocene age is lithologically similar to the units of known Oligocene age. The Miocene or Pliocene sedimentary tuff comprises a lower unit, consisting largely of thick beds of gravel and sandstone, and an upper unit of tuffaceous sediments.

Two map units include sediments of probable late Tertiary and Quaternary age and 5 map units are of Quaternary age. The late Tertiary and Quaternary sediments comprise a unit of pediment and fan gravels and a unit of flood plain gravel. The Pleistocene and Recent map units are older Pleistocene fan deposits, younger Pleistocene to Recent fan deposits, Recent fan deposits, mantle, and alluvium. Mantle blankets much of the southern part of the map area and smaller areas farther N. and comprises terrace gravels, slope wash, silt of probable eolian origin, and small areas of alluvium. Recent clay, silt, sand, and gravel constitute the alluvium along the Missouri River and the smaller streams of the area.

The intrusive igneous rocks include 3 general types and may be of 3 different ages. Diabase has been found only as sills in Precambrian rocks and may be late Precambrian in age. Sills, dikes, and partly concordant plutons of diorite porphyry and related rock types are intrusive equivalents of the Elkhorn Mountains volcanics and probably were intruded during the early stages of deformation. A stock of monzonite cutting across folded Elkhorn Mountains volcanics W. of Lone Mountain was almost certainly emplaced after the main period of folding and may be of about the same age as the Boulder batholith to the W., probably very late Cretaceous.

The Precambrian rocks were broadly arched and beveled by erosion before Middle Cambrian time. From Cambrian until Late Cretaceous time the area was essentially stable, though several erosional unconformities probably indicate epeirogenic movement, or crustal warping on a regional scale.

Immediately preceding the outpouring of the Elkhorn Mountains volcanics, in the early part of the Late Cretaceous, the rocks in the southwestern part of the area were gently folded, and subsequent to the outpouring of the volcanic rocks, in the latter part of Late Cretaceous time, all the rocks in the area were strongly folded and faulted. The major structural features formed during this major orogeny were the broad, transversely faulted anticline in the Limestone Hills, the tightly folded and thrust-faulted anticlinorium in the Hossfeldt Hills, including part of the Lombard thrust zone, and the broad syncline W. of the Hossfeldt Hills. During one or more periods of Tertiary deformation, the mountains bordering the Townsend Valley were uplifted along range-front faults, and the Tertiary rocks in the valley were tilted and cut by faults of relatively small displacement.

Few exploitable metallic mineral deposits have been found within the area. Considerable Au has been recovered from bench gravel and valley-bottom alluvium along Indian Creek, and a little has been mined from small lode deposits W. of Lone Mountain and in the Limestone Hills. Replacement deposits in limestone about 5 mi. W. of Lone Mountain have yielded a few thousand tons of Pb-Zn ore.

Unexploited channels probably occur in the Indian Creek placer area, and undiscovered lode deposits of Au and of Pb and Zn may occur W. of Lone Mountain, especially in parts of the area that are blanketed by Tertiary rocks, but the chance of finding large new placer or lode deposits is slight. Low-grade U deposits may occur in Tertiary rocks, particularly near the northern boundary and in the SW. part of the area.

Limestone for building stone, quartzite for cement, and gravel for road metal have been mined in the area. Deposits of impure bentonite in Tertiary rocks have not been exploited. --Auth.

2. GEOMORPHOLOGY

See also: Geologic Maps 1-552, 1-558, 1-564; Engineering Geology 1-779.

1-632. Livingstone, D. A. THEORY OF ICE AGES: Science, v. 129, no. 3347, p. 463-65, Feb. 20, 1959, 13 refs.

M. Ewing and W. L. Donn theorize that ice ages began when the North Pole migrated into the Arctic Ocean, the semi-isolated position of which causes climatic oscillations with a period and amplitude of the proper magnitude to account for all the observed environmental changes of the Pleistocene. However, it would seem probable that such a system would, on the contrary, be a self-regulatory one, i.e., an ice-free Arctic Ocean would cause glaciers to form, which would immediately remove water from the sea, reducing the flow of warm Atlantic water into the Arctic basin and causing the formation of pack ice which would reduce snowfall on the adjacent land and shrink the glaciers.

Other arguments in opposition to the Ewing and Donn theory of ice ages are given. Ewing and Donn defend their theory in a discussion following Livingstone's criticism (p. 464-64). --G. E. Denegar.

1-633. Aronow, Saul. DRUMLINS AND RELATED STREAMLINE FEATURES IN THE WARWICK-TOKIO AREA, NORTH DAKOTA: Am. Jour. Sci., v. 257, no. 3, p. 191-203, 3 maps, geol. secs., March 1959, 22 refs.

NE.-trending drumlins and related streamline features of late Pleistocene age are found in the Warwick-Tokio area of the Devils Lake region of North Dakota. These features range from small drumlins to large ridges or "scorings" in end moraines. Some isolated end moraine patches contain exposures of Pierre shale bedrock of Cretaceous age. These bedrock "highs" seem to have controlled the location of the morainal patches but do not seem significant in the origin of the streamline features. The origin of the streamline features is uncertain but they are probably erosional rather than depositional. Why they are localized in this part of the Devils Lake region and absent elsewhere is not clear. No significant differences of terrain or materials were found among the various parts of the region. Possibly some as yet unknown factor in the now vanished ice is responsible for their formation in this small area. --Auth.

1-634. Wolman, M. Gordon. FACTORS INFLUENCING EROSION OF A COHESIVE RIVER BANK: Am. Jour. Sci., v. 257, no. 3, p. 204-16, 2 illus., graphs, 3 tables, March 1959.

The sinuous channel of Watts Branch in Montgomery County, Maryland, traverses a grassy meadow nearly devoid of trees. The creek has a drainage area of 4 sq. mi., and the river bank is composed primarily of cohesive silt. Resurveys of cross sections during the 5 years 1953-1957 have revealed as much as 7 ft. of lateral erosion. Over the past 2 years, additional measurements of the amount of erosion around rows of steel pins driven horizontally into the bank have been made at frequent intervals. These observations indicate several combinations of factors primarily responsible for the progressive recession.

Approximately 85% of the observed erosion occurred during the winter months of Dec., Jan., Feb., and March. A thickness of as much as 0.4 ft. of sediment was eroded from the bank at specific points in a period of several hours during which a bankfull flow attacked banks which had previously been thoroughly wetted. Erosion was most severe at the water surface. Little or no erosion was observed during the summer despite the occurrence of the highest flood on record in July 1956.

Second in erosion effectiveness were cold periods during which wet banks, frost action, and low rises in stage combined to produce 0.6 ft. of erosion in 6 weeks during the winter of 1955-56. Significant erosion also resulted from the combination of moist banks and low rises in stage. Lastly, crystallization of ice and subsequent thawing, without benefit of changes in stage, also produced some erosion as did flashy summer floods even on hard dry banks. Inasmuch as such summer floods constitute the rare and "catastrophic" events on small drainage basins in this region, present observations suggest that the cumulative effect of more moderate climatic conditions on this process of erosion exceeds the effect of rarer events of much greater magnitude.

This preliminary analysis of several factors responsible for erosion of the cohesive river bank indicates that there is perhaps a crude correlation between precipitation and erosion during selected intervals of time. Precipitation exerts an effect both through increasing discharge in the channel and by increasing the moisture in the bank. Frost action acts similarly both to hold moisture in the soil and to comminute surface material, thus preparing it for erosion. --Auth.

1-635. Curtis, Neville M., Jr. **CAVES IN THE ARBUCKLE MOUNTAINS AREA, OKLAHOMA: Oklahoma Geol. Survey, Oklahoma Geology Notes, v. 19, no. 2, p. 20-31, 2 illus., 11 maps, Feb. 1959.**

The Oklahoma Geological Survey is attempting to build a file on caves in the State which will be of value to the geologist, biologist, archeologist, historian, and "speelunker." Descriptions are given, with plans, of 10 better known caves in the Arbuckle Mountain region, noting location, geology, folklore, equipment needed for exploration, etc. --A. C. Sangree.

1-636. Nikiforoff, C. C. **REAPPRAISAL OF THE SOIL: Science, v. 129, no. 3343, p. 186-96, illus., map, Jan. 23, 1959, 24 refs.**

Soil or its geochemical equivalent might be defined as an excited skin of the subaerial part of the earth's crust. The excitation is caused by continuous bombardment of extraneous energy from solar radiation and from slow atomic decay of radioactive elements in the earth's crust. Continuous charging with extraneous energy transforms the thin exterior layer of the relatively inert crust into a thermodynamic system.

An essential part of soil dynamics consists of movements representing various chemical reactions. The surface of soil-solid particles is bombarded by free ions of O, CO_2, H, and hydroxyl of dissociated water, as well as by whole bipolar water molecules, resulting in conspicuous oxidation, carbonation, and hydration of soil.

Physical and chemical processes, or "pedogenic" processes, make up only a short segment of the dynamic equilibrium, or steady state of the soil system, maintained by the broader geochemical cycles. The behavoir of carbon in the pedogenic process illustrates the general trend of the migration of elements through the soil. Each reaction in this migration imparts to the initial material certain new characteristics and is accompanied by a certain change in the energy content of the reactants and of the products. Localization of different forms of activity and the differential alteration of the initial material by these forms of activity imparts to the soil its profile.

Every thermodynamic system in equilibrium with its environment reacts to changes in that environment. The surroundings which determine the steady state of soil are a local combination of climate, land form, biological pressure, and the initial material.

Local differences indicate that soil formation involves not only a differentiation of genetic horizons, giving soil a certain morphological profile, but also differentiation in a horizontal plane, which makes soil a patterned spatial system. --G. E. Denegar.

1-637. Thames, John L. **MEASURING SOIL MOISTURE OVER LARGE AREAS WITH SINGLE INSTALLATIONS OF MOISTURE UNITS: Jour. Geophys. Research, v. 64, no. 2, p. 257-62, 5 graphs, 3 tables, Feb. 1959, 8 refs.**

It seems possible that, with proper calibration, single installations of electrical soil-moisture units can be used to estimate moisture contents of outlying sites receiving similar amounts of rain but differing in vegetation and soils. In tests with data from northern Wisconsin and W.-central Mississippi, predicted moisture contents agreed closely with those obtained by on-site measurements. Results were most accurate at seasons when the soils remained near the wilting point or near field capacity and were least accurate during periods of recharge. --Auth.

1-638. van't Woudt, Bessel D. **PARTICLE COATINGS AFFECTING THE WETTABILITY OF SOILS: Jour. Geophys. Research, v. 64, no. 2, p. 263-67, table, Feb. 1959, 7 refs.; also pub. as: Hawaii Agr. Expt. Sta., Misc. Paper no. 107.**

The fundamental principles underlying the process of wetting show that a reduction in the surface tension of a solid substance to be wetted reduces the wettability. Conversely, a reduction in the surface tension of the applied liquid increases the wettability. The wetting of a soil, which exhibits water-repellency in an air-dry state, can sometimes be achieved by leaving water in contact with this soil. There is some evidence that this wetting is achieved by an interaction of the solid and the liquid phase, leading to a reduction in the surface tension of the liquid. The phenomenon of advancing and receding angle of contact had led to an hypothesis that the angle of contact changes as the soil wets up or dries out. Some evidence is presented which does not support such an assumption, as the angle of contact seems fixed at a moisture content just above air-dry. There is some evidence that under certain conditions an improvement in the base status of the soil may lead to improved wettability. Particle coatings by hydrophobic films are in some cases responsible for the observed water-repellency. There is some evidence that this film is strongly adsorbed. No quantitative relationship could be detected between the characteristics of substances extracted by chloroform from a problem soil and the degree of unwettability of such a soil. --Auth.

1-639. Sigafoos, Robert S. **VEGETATION OF NORTHWESTERN NORTH AMERICA, AS AN AID IN INTERPRETATION OF GEOLOGIC DATA: U. S. Geol. Survey, Bull. 1061-E, p. 165-85, 7 illus. (1 in pocket) incl. vegetation map, scale 1:2,500,000, table, 1958, pub. Jan. 1959, 31 refs.**

A distribution map of the major forest groups of northwestern North America and some treeless vegetation types of parts of Alaska has been prepared from published large-scale maps and data collected during recent field studies by the U. S. Geological Survey. The most common plant communities in the interior spruce and birch forest, coastal spruce and hemlock forest, and treeless regions are briefly described. Engelmann spruce and lodgepole pine grow in the extreme southeastern part of the region mapped. Examples are cited to demonstrate the importance of a knowledge of vegetation in aiding in interpretation of local distribution of permafrost, and the significance of upper Pleistocene and recent fossil plants, and as a part of background material for future ecologic, geomorphologic, and hydrologic studies. The usefulness of accurate knowledge of the geographic distribution of various species is discussed, and maps of the principal tree species are included. --Auth.

1-640. White, William A. SOME GEOMORPHIC FEATURES OF CENTRAL PENINSULAR FLORIDA: Florida Geol. Survey, Bull. 41, 92 p., 6 illus., 11 maps, 1958.

The Withlacoochee Valley between Richlands and Dunnellon was formerly occupied by a large lake which drained through the Hillsborough River. Solution made a new outlet (present lower Withlacoochee River) at Dunnellon in post-Pamlico time. Lakes Tsala-Apopka and Panasoffkee occupy depressions in the bed of the ancestral lake. The Hillsborough River still receives water from the Withlacoochee.

Relict beach ridges drop 80 ft. in passing from insoluble rocks in Polk County to soluble ones in Lake County, suggesting that subsidence has been a large factor in late topographic history of the area underlain by soluble rocks.

Lake Wales Ridge lies in the same lineal trend as Trail Ridge. A zone of dunes along its eastern side continues across the broad gap between the ends of the 2 ridges suggesting that they were a single continuous ridge until solution lowered the part which rested on soluble rocks.

The drainage on the tops of the Lake Wales and Lakeland ridges is southeastward and seems to be a remnant of a former regional trend.

The peninsular divide is transverse (Cape Canaveral to Indian Rocks). It seems to result from a succession of ancestral capes which were localized by a structure.

No evidence was found for late westward tilt of the peninsula.

The large shallow lakes are ascribed to solution by shallow horizontal movement of ground water through sand, over limestone in areas where the piezometric surface is above the land surface. No lakes occur where limestone lies bare at the surface. --Auth.

1-641. Norris, S. E., and H. C. Spicer. GEOLOGICAL AND GEOPHYSICAL STUDY OF PREGLACIAL TEAYS VALLEY IN WEST-CENTRAL OHIO: U. S. Geol. Survey, Water-Supply Paper 1460-E, 34 p., fig., 2 pls. (in pocket), Jan. 1959, 46 refs.

The U. S. Geological Survey and the Division of Water, Ohio Dept. of Natural Resources, have explored, as part of a cooperative program of water-resources investigations, the buried Teays Valley of Tertiary age and associated deposits in 3 counties of W.-central Ohio. Earth-resistivity methods were used to locate the buried Teays Valley and to trace its course before test drilling was begun. The apparent resistivity of the earth was computed by the Wenner formula; interpretation of the 3 resistivity curves obtained for each depth profile was by methods based on the theory of images. Computed resistivity values for the unconsolidated deposits ranged between 1,670 and 69,000 ohm cms.; for the consolidated rocks the range was between about 2,500 and 41,000 ohm cms. Test holes drilled later at critical sites revealed the depth of the buried valley, its gradient and configuration, and the character of the valley-fill deposits.

The Teays River was the master stream for the drainage from a large part of the Appalachian region in late Tertiary time. It originated in the Piedmont Plateau of Virginia and North Carolina and flowed generally northwestward across West Virginia and southern Ohio where its course S. of the glacial drift is revealed by abandoned valley segments and terrace remnants above the present drainage. In the area of glacial drift the course of the buried Teays Valley has been traced, largely from well records, across western Ohio, northern Indiana, and Illinois to the Mississippi embayment.

The Teays was a mature stream. Its valley in southern Ohio, where it is cut into shale and sandstone of Mississippian age, averages about 1 1/2 mi. in width, has a flat floor and steep sides, and is about 200 to 300 ft. below the general level of the uplands. In W.-central Ohio, where it is cut into limestone and dolomite of Silurian age, the buried Teays Valley is about 3,000 ft. wide in the narrowest place, the valley walls are steep, and the valley floor is 400 ft. or more below the general level of the bedrock surface. The gradient of the Teays Valley in southern Ohio is about 9 in. per mile; its gradient in the area of this investigation is about 10 in. per mile. The buried valley declines in altitude from 568 ft. in S.-central Madison County to 538 ft. in southern Champaign County, over a channel distance of about 35 mi.

The Teays River was dammed somewhere in its lower course, possibly in northeastern Indiana, by a pre-Illinoian glacier. This ponded the waters and produced widespread finger lakes in the Teays Valley and its tributaries in which were laid down extensive deposits of finely laminated silts and clays. Stout and Schaaf (1931) named these silts and clays the Minford silt from exposures in southern Ohio. Test drilling has revealed that clay typical of the Minford at the type locality in southern Ohio is the principal deposit in the buried Teays Valley in W.-central Ohio, in association with scattered deposits of fine-grained sand. The clay and the associated sand are assigned to the Minford silt. The clay is 264 ft. thick at the London Prison Farm in western Madison County; its median thickness in 12 test holes is 100 ft. In most places the clay lies directly on the bedrock which, prior to the deposition, must in places have been swept clean of stream alluvium. The authors believe that this erosion occurred just before the ice dammed the Teays, when its flow was augmented by water diverted, through a col at Sardis in the Ohio Valley, from the basin of the northward-flowing Pittsburgh River, which was dammed a little earlier. The fine sand associated with the lacustrine clays in the area of this investigation is believed to have originated as glacial outwash and was contributed by meltwaters from the ice front, mingling with the finer grained sediments carried into the ponded Teays basin by headwater streams.

This investigation reveals that the fine-grained, unconsolidated deposits in the buried Teays Valley in W.-central Ohio are not important as a source of ground water. Somewhere downstream, however, the predominantly lacustrine deposits in the buried valley give way to coarser grained deposits largely of glacial origin. The authors suggest a plan for prospecting the Teays Valley by geophysical methods and test drilling throughout the remainder of its course in Ohio to ascertain where it was dammed by the early glacier and where, as a consequence, it may contain outwash sands and gravels of possible importance as sources of ground-water supplies. --Auth.

3. STRUCTURAL GEOLOGY

See also: Geologic Maps 1-562, 1-567, 1-569, 1-624; Stratigraphy 1-650; Geophysics 1-672; Fuels 1-772, 1-776.

1-642. Andreyeva, I. B., and G. B. Udintsev. **STROYENIYE DNA YAPONSKOGO MORYA PO DANNYM ISSLEDOVANIY EKSPEDITSII NA "VITYAZE" [THE STRUCTURE OF THE BOTTOM OF THE SEA OF JAPAN ACCORDING TO DATA OBTAINED BY THE "VITYAZ"]:** Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 3-20, map, 4 diags., 7 graphs, 3 tables, 23 refs.

The seismo-acoustic method of sea-bottom study was applied on a large scale by the U.S.S.R., for the first time in 1954, by the Institute of Oceanology of the Academy of Science, U.S.S.R. in the northwestern part of the Pacific Ocean and, in 1957, for the study of the bottom of the Sea of Japan. The research ship "Vityaz" was especially built for this kind of research. Her equipment and instruments were devised by the Institute of Acoustics of the Academy of Science of the U.S.S.R. The authors describe the results of these studies which were largely based on methods developed abroad, such as the study of reflected and refracted sound-waves produced by explosive charges dropped to the sea bottom. In this way, 3 strata were discovered on the bottom of the western part of the basin of the Sea of Japan. The first is a superficial sedimentary stratum 1 to 1.5 km. thick. The second is an underlying basaltic stratum 6.5 to 7.5 km. thick. The third is composed of ultrabasalts. It was also found that the primary complex-tectonic relief of the Sea of Japan basin was covered by a thick smooth sedimentary layer. --LC.

1-643. Weeks, Lewis G. **GEOLOGIC ARCHITECTURE OF CIRCUM-PACIFIC:** Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 350-80, 8 figs. incl. maps, diags., Feb. 1959, 7 refs.

Belts of mobility form the most prominent features of the circum-Pacific belt. Thus they are of primary interest in any discussion of its geologic architecture. Historically, they have been the most active major features of the earth's crust. Their manner of development holds the key to the origin, growth, and real nature of continents.

The circum-Pacific mobile belt is peripheral both to the high-standing, deep-rooted, approximately andesitic composition continental crust and to the broad basaltic crustal plate underlying the Pacific Ocean. It was in similar peripheral zones, now along one continental margin, then along another, that former mobile belts were initiated, developed through several hundred million years each, and were finally stabilized. Throughout geologic history, many additions were made to the margins of the continental crust by this process. Accompanying this build-up of the various continental nuclei, the always stable basaltic ocean crustal plates have, on balance, correspondingly diminished in area, and their waters have deepened.

Additions to the lighter continental crust through mobile belts were effected mainly by differential subtraction of the lighter, more silicic, more alkalic constituents from the ultrabasic subcrust. This process left the latter still more basic, and added the subtracted materials to the newly forming continental crust by volcanism and other extrusives and intrusives. These materials were fed upward along several-hundred-mile-deep earth fractures or zones of disturbance. The position, depths reached, and nature of these great master "fractures" is being revealed by studies of earthquakes and volcanism, both of which are concentrated today in the circum-Pacific mobile belt. These great master "fractures" are now known to be one of the main, if not the primary controlling feature in the development life of mobile belts. Sediments derived mainly from the older, continental lands, but also from newly formed, peripheral island-arc masses accumulated in geosynclines and, in considerable part, ultimately were metamorphosed or even "granitized" before the diastrophic cycle had run its course.

All stages in the diastrophic-sedimentary cycle of the typical mobile belt are represented in the circum-Pacific architecture. Thus, the various sectors of the circum-Pacific are described against the background of the sequence of stages in the life history of a typical mobile belt.

After the diastrophic cycle is finished, mountains of the newly stabilized belt are eroded to their metamorphosed, intruded, and crystallized roots; thus one more section is added to the continent. Continent-building has probably been continuous by means of mobile belt activity; before one diastrophic cycle was complete others were beginning elsewhere. The new may develop in parallel fashion outside the old or may shift to another flank of the continent. In this manner continents have grown, on balance, for here and there marginal areas have also been lost to the seas.

Throughout decipherable geologic history mobile belts present a similar architectural pattern. Likewise, they present a similar cross-sectional distribution, from rear to front, of rock types: sedimentary, igneous, and metamorphic. Their history and manner of growth have been strikingly similar. And so also is the distribution of petroleum in relation to them.

Some now enclosed maturing sea basins of the circum-Pacific have been accumulating large quantities of sediment since Paleozoic time. These basins are of the type in which large volumes of oil have been found or will be found in the future. There seems little doubt that much oil occurs in the sedimentary sections lying below these sea bottoms; its recovery is largely an engineering problem.--Auth.

1-644. Béland, R., and P. E. Auger. **STRUCTURAL FEATURES OF THE NORTHERN PART OF THE LABRADOR TROUGH:** Royal Soc. Canada, Trans., Sec. 4. Geol Sci., 3d ser., v. 52, p. 5-15, 4 figs. incl. 2 geol. maps (1 fold.), cross-secs., June 1958, 24 refs.

Most of the Labrador Trough is pictured as an asymmetrical geosyncline which began as a half graben. But the Payne Bay-Roberts Lake segment is a semi-isolated basin along the rim of which the same sedimentary formations outcrop continuously.

The structural lineaments in the basin have the same attitudes as in the main part of the Trough at Leaf Bay. Along the E. side dips are steep, with overturning, and contacts are sheared. Along the W. side the rocks are less deformed, and the folding has been influenced as much as by the shape of the Archean floor as by tectonic shoving from the NE.

At Ford Lake, the thicker parts of the iron-formation lie in embayments and show evidence of lagoonal deposition. --Auth.

1-645. Small, Walter M. **THRUST FAULTS AND RUPTURED FOLDS IN ROMANIAN OIL FIELDS:**

Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 455-71, 2 maps, 5 secs., Feb. 1959, 17 refs.

Overthrust faults and ruptured, asymmetrical salt folds overriding one flank occur in the Romanian oil fields where deep drilling gives control on subsurface conditions.

The folding developed very gradually during early Pliocene along axial lines already existing in the Miocene and older Tertiary rocks; thus accumulation of oil and gas in the lower Pliocene (Meotian) and middle Pliocene (Dacian) must have taken place before the large-scale folding and faulting (Wallachian) of the last stage (Levantine) with vertical movements of several thousand feet. Salt and salt breccia were squeezed into or through some of the folds or rupture lines, for the weight of the Pliocene was enough to bring the salt masses to a plastic state.

With 10,000-15,000 ft. of sediments, most of which were unconsolidated, lying on a sloping foundation of the Carpathian foreland, it is easy to visualize the long strike folds pressing forward and down the slope as the uplift of the Carpathians reached its climax. Salt and salt breccia, along with fluids and gases entrained along lines of movement, served as lubricants. We may assume a buoyant effect of submergence to lighten the load, for the Levantine was still a lake when much of this happened.

There is little indication of movement of reservoir contents far from the original places of accumulation. Where faulting has afforded communication between Meotian paraffinic and Dacian nonparaffinic oil-bearing sands, crudes of mixed base are found in the latter.

The Baicoi field has an interesting structural feature where large crestal and N. flank production was found about 5,000 ft. above the faulted S. flank, with the same prolific oil sands.

The origin of the salt is a long disputed question. In recent years, many Romanian geologists ascribe it to the Tortonian, in which lagoonal salt beds occur. Evaporites are also reported in the Helvetian and in the Aquitanian. In either or both cases, they could take part in the diapir movements. The writer believes the original salt masses started from pre-Aptian Mesozoic. --Auth.

1-646. Shafiro, Ya. Sh. NOVYYE DANNYYE PO TEKTONIKE SEVERNYKH YERGENEY [NEW DATA ON THE TECTONICS OF SEVERNYYE YERGENI]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 46-55, 3 maps, diag., 8 refs.

The study of the complicated structure of the "Severnyye Yergeni" [47°N. 44°E.] showed that this region has been subjected to many tectonic events since the Paleozoic era, when the formation of the folded structure of the southwestern part of the region and the down-warping of its larger part occurred. The down-warping became more intensive in the Permo-Triassic period, and the depression was filled in the Lower Triassic period with thick deposits of multi-colored rocks. Since the end of this period the whole region has been subjected to alternate subsidence and elevating processes. In the Oligocene epoch, the whole region was covered with a sea, which retreated in the Miocene epoch when the region finally became dry land. Its eastern part subsided again in the Sarmatian stage, but emerged at the end of the Miocene epoch. The author describes the various structural changes and different sedimentary formations resulting from these tectonic events. He mentions the following geologists whose work he has summarized in this article: A. P. Karpinskiy, A. D. Arkhangelskiy, N. S. Shatskiy, Ye. V. Milanovskiy, and A. G. Brazhnikov. --LC.

1-647. Smirnov, A. M. O SOCHLENENII MONGOLO-OKHOTSKOGO I TIKHOOKEANSKOGO SKLADCHATYKH POYASOV I KITAYSKOY PLATFORMY [JUNCTION OF THE MONGOLIA-OKHOTSK AND PACIFIC FOLD BELTS WITH THE CHINESE PLATFORM]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 76-91, 5 maps, 23 refs.

The southern part of the Soviet Far East and the adjacent territories of China and Korea are situated on the junction of major geotectonic zones: the Siberian platform in the N., the Chinese platform in the S., the western zones of Pacific fold belts, and the Mongolia-Okhotsk fold belt located between the platforms. Very little is known of the geologic structure of the Chinese territory. The author, using what little information is available, propounds the hypothesis that during the Caledonian cycle a northern shelf of the Chinese platform existed, on which a secondary geosyncline was developed in the middle Paleozoic era and was completed by the end of the Permian. According to Yu. M. Sheynman, the Chinese platform spreads as far N. as the Zeysko-Bureinskaya Vpadina (depression; 51°N. 129°E.), which is considered to contain the remains of the platform. At the end of the Hercynian cycle, a late-Hercynian fold zone extended between this depression and the Chinese platform (actually called Pacific fold belt). The Mongolia-Okhotsk fold belt borders the Siberian platform in the N.; in the S., the Manchurian zone (forming the S. part of this belt) of late-Hercynian folding, borders the Chinese platform. The author describes the sequence of regional geotectonic events during the upper Paleozoic era. Many suppositions are hypothetical as further studies of the whole region are required. --LC.

1-648. Vongaz, L. B. O PALEOZOYSKIKH STRUKTURNO-FATSIALNYKH PODZONAKH TURKESTANO-ALAYSKOY GORNOY SISTEMY (YUZHNYY TYAN-SHAN) [PALEOZOIC STRUCTURAL UNITS OF THE TURKESTAN-ALAY MOUNTAIN SYSTEM (SOUTHERN TIEN-SHAN)]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 65-76, 3 maps, table, 6 refs.

The author divides the Turkestan-Alay mountain system [39°30'N. 69°-70°E.] into 2 groups of subzones, clearly defined by their structural characteristics. The first group is comprised of the Zeravshanskiy Khrebet-Alayskiy Khrebet, the High Foothills subzones formed by lower(?) and middle Paleozoic anticlines (of second order), and by upper Paleozoic anticlines (of second order). The second group is formed by the Gulcha and Kara-Chatyr subzone, lower(?) and middle Paleozoic geanticlines (of second order), and upper Paleozoic geosynclines (of second order). This means, that the subzones of the second group have an inverted rhythm of basement oscillatory movements. These movements also determine the different development of all other geological features in each subzone, and explains the different structure of their Paleozoic basement. The main differences are as follows: 1) the subzones of the first group have a thick lower(?) middle Paleozoic foundation formed by shaly, volcanic, carbonaceous beds representing open-sea deposits. Upper Paleozoic accumulations are almost absent; they are found only in separate local depressions and are formed of coarse clastic rocks; 2) the Paleozoic basement of the subzone of the second group are of an exactly opposite type: folded Paleozoic structures of the subzones of the first group were formed by lower Permian movements with a notable participation of pre-upper Carboniferous movements. The structures of the subzones of the second group were formed later by the upper Permian movements with the participation of lower Permian movements; 3) the magmatic process was different in both groups, due to their different age of formation. During the period of general sinking (corresponding to the lower-middle Paleozoic for the first group and upper Paleozoic for the second group of subzones), the subaqueous outflow of basic and intermediate extrusives occurred. At the end of the Paleozoic geosynclinal stage (for the subzones of the first group, in the lower Permian(?), and for the second group, in upper Permian), together with the principal phase of folding, massive introduction of acid intrusives occurred; 4) the scheme of folding in the Turkestan-Alay system in the first group was the development of downwarp of the synclinal structures in the lower (?)-middle Paleozoic, with the amplitude of the subsidence increasing from the periphery to the central part of the subzones. On the boundaries of lower and middle Carboniferous, the general downwarp of the subzones is replaced by their general elevation. The folded Hercynian structure of the first group, formed at the end of their upper Paleozoic elevation, presents an obvious synclinorium. In the subzones of the second group, a general elevation of the anticlinal structures was developed during the lower(?)-middle Paleozoic, with the amplitude of the elevation increasing from the periphery to the central parts of the subzones. On the boundaries of the lower and middle Carboniferous, this elevation is replaced by general subsidence. The folded Hercynian structure of the second group formed by the end of the upper Paleozoic depression (at the beginning of the upper Permian) formed in general an anticlinorium; 5) the sharp inversion of the oscillatory movements in both groups of subzones does not involve the inversion of the basic folded structures because the general elevation of the first group and the general sinking of the second occurred in separate blocks divided by a plutonic break. The author substantiates his findings with numerous studies of other geologists, although he disagrees with some of them. Following geologists were mentioned by the author: A. V. Peyve, V. I. Popov, N. M. Sinitsy, D. P. Rezvoy, A. D. Arkhangelskiy, and N. S. Shatskiy. --LC.

4. STRATIGRAPHY AND HISTORICAL GEOLOGY

See also: Geologic Maps 1-622; Paleontology 1-664, 1-665; Geochemistry 1-706, 1-709, 1-710; Mineral Deposits 1-754; Fuels 1-769, 1-770.

1-649. Zhirmunskiy, A. M. YESHCHE O STRATIGRAFICHESKOM SLOVARE SSSR [MORE ABOUT THE STRATIGRAPHIC INDEX OF THE U.S.S.R.]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 105.

The author cites articles by V. A. Grossgeym, V. Ye. Khain, and T. A. Sikstel, published in No. 10, 1957, of this periodical, about the defects of the "Stratigraphic Dictionary of the U.S.S.R.," edited by VSEGEI. The author mentions geological terms this dictionary omitted, though they were used in works of Academicians A. P. Pavlov and I. M. Gubkin. These words are: Antropogen (Anthropogen), Antropozoy (Anthropozoic Era), Gyunts (Gunzian Stage), Mindel (Mindelian Stage), Riss (Rissian Stage), Vyurm (Würmian Epoch), Neovyurm (Neo-Würmian Epoch). The term "Antropozoyskaya era" (Anthropozoic Era) is recognized by the Academy of Sciences of Czechoslovakia, which, since 1951, published 5 volumes under the general name of "Anthropozoikum."--LC.

1-650. Pavlovskiy, Ye. V. GEOLOGICHESKAYA ISTORIYA NAGORIY SHOTLANDII V DOKEMBRII I NIZHNEM PALEOZOYE I ROL GLUBINNYKH RAZLOMOV [THE GEOLOGIC HISTORY OF THE SCOTTISH HIGHLANDS IN THE PRECAMBRIAN AND LOWER PALEOZOIC PERIODS AND THE ROLE OF DEEP-SEATED FAULTS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 3-19, 7 figs., table, 50 refs.

This is a second part of an article by Pavlovskiy, which appeared in No. 6, 1958, of this periodical [GeoScience Abs. 1-94], describing the development of Scotland in the Precambrian and Lower Paleozoic periods. --LC.

1-651. Keller, B. M., I. N. Krylov, and Ye. V. Negrey. PALEOZOY ZAPADNOGO PRIBALKHASHYA V RAYONE POSELKA MYNARALA [PALEOZOIC FORMATIONS OF THE WESTERN PART OF THE BALKHASH REGION NEAR THE VILLAGE OF MYN-ARAL]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 56-71.

The strata of Paleozoic formations observed in the western part of the Balkhash region [46°N. 74°E.] contain numerous fossils of Paleozoic fauna and flora which exactly determine the age of the different stages and their relation to various epochs of the Paleozoic era. Study of the cross-section showed that after the initial subsidence of Archean gneisses and granites and the formation of a Proterozoic-Cambrian series of sand-shale rocks, a general elevation of the region occurred, and it was subjected to an important pre-Ordovician erosion. In the Ordovician system, deposits of Llanvirnian, Llandeilian, and Caradocian stages were identified by fossilized fauna. In the same way deposits of the Silurian system were identified as belonging to Llandovery, Wenlock, and Ludlow stages. In some parts of the region, Tarannon shales were also found. In general, the Silurian system is represented by volcanic-fragmental and reef facies. The Devonian volcanic sequence of the region is represented by 3 lenticular rock formations, belonging respectively to the Lower, Middle, and Upper Devonian series. The following Carboniferous system is represented by formations of conglomerates and tuffs, identified as usual by fossil fauna. These layers are covered by layers of sandstones and aleurolites (silts). Intrusive bodies of various age found in the Myn-Aral [45°25'N. 73°38'E.] region belong mainly to three groups: Archean granites and gneisses, Caledonian tonalites, and early-Hercynian granites. The following geologist and paleontologists are mentioned for their research in this field: D. I. Yakovlev, A. M. Belyayev, A. Ye. Repkina, V. N. Veber, O. I. Nikiforova, P. I. Stepanov, L. B. Rukhin, V. S. Koptev-Dvornikov, L. V. Dmitriyev, A. V. Kozlov, Ye. V. Negrey, V. A. Pavlov, O. P. Kovalevskiy, V. A. Sytov, M. N. Chugayev, B. M. Keller, A. M. Obut, T. B. Rukavishnikova, V. A. Khakhlov, G. R. Shiskhina. --LC.

1-652. Gardner, Louis S. REVISION OF BIG SNOWY GROUP IN CENTRAL MONTANA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 329-49, 4 figs. incl. map, columnar secs., Feb. 1959, 28 refs.

The 1,500 ft. or so of Carboniferous rocks above the Madison group in the Big Snowy Mountains of central Montana are here divided into 6 lithically and faunally intergrading formations. They are believed to represent an almost continuous depositional sequence of mainly shallow-water sediments that formed near the center of an episodically subsiding marine basin during Late Mississippian and Early Pennsylvanian time. Marginal overlaps and locally discordant relations, attributable to intervals of accelerated subsidence of shoaling, are likely to be prevalent along the now mainly buried shelf-edges of this irregular basin.

As a name for the entire intergrading sequence, the Big Snowy group of Scott is expanded and redefined to include, in ascending order, not only the Kibbey sandstone, Otter formation, and Heath formation of his original report, but also 3 overlying formations - the newly named Cameron Creek formation, the Alaska Bench limestone, and the newly named Devils Pocket formation. The Charles formation, which Seager added to the base of the Big Snowy group in 1942, was properly reassigned to the underlying Madison group by Sloss in 1952. --Auth.

1-653. Nelson, Samuel J. BRACHIOPOD ZONES OF THE MOUNT HEAD AND ETHERINGTON FORMATIONS, SOUTHERN CANADIAN ROCKIES: Royal Soc. Canada, Trans., Sec. 4. Geol. Sci., 3d ser., v. 52, p. 45-53, 2 figs., June 1958, 13 refs.

Brachiopod assemblages from the Mount Head (Meramecian) and Etherington (Chesterian) formations are arranged according to zones. Zones recognized are the Spirifer bifurcatus, Echinoconchus biseriatus, and Girtyella indianensis of lower, middle, and upper Mount Head, respectively; the Gigantoproductus brazerianus zone of uppermost Mount Head and lowermost Etherington; and the Dictyoclostus parvus, Punctospirifer transversa and Diaphragmus cestriensus zones of lower, middle, and upper Etherington, respectively. A possible higher zone, the Spirifer matheri, found at one locality suggests that the uppermost Etherington may be, in part, Pennsylvanian.

Type Tunnel Mountain formation is thought to be Pennsylvanian in age, not Chesterian as commonly asserted. --Auth.

1-654. Kossovskaya, A. G. ISTORIYA MEZOZOYSKOGO OSADKONAKOPLENIYA V ZAPADNOM VERKHOYANYE I VILYUYSKOY VPADINE [HISTORY OF THE MESOZOIC SEDIMENTATION IN THE WESTERN PART OF THE UPPER YANA REGION AND IN THE VILYUY DEPRESSION]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 37-54, 4 maps, diag., table, 18 refs.

A large table is supplied by the author on which all features of various parts of the above mentioned regions are presented. It represents a recapitulation of works by different geologists and the author. The following scientists took part in these operations: A. G. Rzhosnitskiy, V. N. Andrianov, A. G. Kossovskaya, V. M. Melnikov, G. S. Borushko, A. I. Ushakov, V. V. Panov, N. P. Kheraskov, A. V. Zimkin, L. N. Smirnov, B. S. Abramov, A. Ye. Kiselev, V. A. Vakhrameyev, N. A. Bolkhovitina, V. D. Shutov, V. I. Muravyev, D. S. Korzhinskiy, and others, not mentioned by name. In spite of differences in the structure of the western part of the Upper Yana [71°31'N. 136°32'E.] and of the Vilyuy depression [65°N. 124°E.], a series of large lithologic-genetic complexes common for both parts is defined, reflecting the regular sequence of physical and geographical circumstances of the different stages of the Mesozoic cycle. This cycle began in the Upper Triassic and was finished in the Upper Cretaceous period. In the western part of the Upper Yana region the following complexes were found: 1) lower sand-conglomerate formation, corresponding to the stage of the developing transgression; 2) sand-silt argillaceous formation corresponding to the maximal spreading of the marine basin; 3) upper sand formation, such as the beginning stage of the general regression; 4) coal-bearing formation characterizing the regressive stage of the cycle. The deposits of the Vilyuy depression were divided long ago by A. G. Rzhosnitskiy into 3 genetically different strata: 1) the lower - a fresh-water sandy formation; 2) the middle - a marine sand-argillaceous formations; 3) the upper - a coal-bearing formation. This division still stands, only it is more defined and detailed by the geologists. In general, the author divides the deposits of both regions into various horizons and gives them names according to the rivers or localities where they were found. On the whole, they are all associated with different epochs of the Mesozoic cycle, as shown on the map attached to the end of this periodical. The history of their formation during this period is described in detail. --LC.

1-655. Tuchkov, I. I. OTLOZHENIYA KARNIYSKOGO YARUSA SEVEROVOSTOKA SSSR I IKH NIZHNYAYA GRANITSA [KARNIAN DEPOSITS IN THE NORTHEAST PART OF THE U.S.S.R. AND THEIR LOWER LIMIT]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 87-101, map, table, 17 refs.

The author describes the Karnian deposits (Triassic) in main cross-sections of different regions of the NE. part of the U.S.S.R. He divides these deposits into 2 stages, upper and lower, according to the fossil fauna peculiar to each level, and compares this fauna with fossils found in Karnian deposits of North America, the Alps, and Indonesia. He proposes, as a result of this comparison, to include the lowest part of the Karnian stage containing different species of the Nathorstites, into the Ladinian stage. The following scientists who worked in those regions are mentioned: P. Wittenburg, E. Toll, A. Bunge, P. A. Kazanskiy, M. V. Bayarunas, L. D. Kiparisova, S. V. Obruchev, A. A. Nikolayev, Yu. N. Popov. --LC.

1-656. Frebold, Hans. THE JURASSIC SYSTEM IN NORTHERN CANADA: Royal Soc. Canada, Trans., Sec. 4, Geol. Sci., 3d ser., v. 52, p. 27-37, map, table, June 1958, 13 refs.

This paper outlines the stratigraphy, paleogeography, and faunal composition of a number of Jurassic occurrences in northern British Columbia, the Yukon and the Canadian Arctic, based on collections made during the past few years. The sequence of events during the Jurassic is shown to differ considerably in these various regions. Faunistic and stratigraphic correlations are made with other parts of Canada, the United States, Europe, and Arctic regions other than Canada. --Auth.

1-657. Warren, P. S., and C. R. Stelck. THE NIKANASSIN-LUSCAR HIATUS IN THE CANADIAN ROCKIES: Royal Soc. Canada, Trans., Sec. 4. Geol. Sci., 3d ser., v. 52, p. 55-62, 3 maps, chart, June 1958, 16 refs.

The basal Nikanassin of the type section in the central Alberta Foothills is known to yield fossils referable to the Oxfordian stage of the Jurassic. Floras with Luscar affinities are known to occur above Neocomian (Lower Cretaceous) marine deposits in the Peace River area. In type area the unconformable boundary between the Nikanassin and Luscar formations is defined by the Cadomin conglomerate. The hiatus indicated by this unconformity is represented in the Peace River basin by a continuous sequence of Aucella-bearing beds of the upper Nikanassin (Upper Jurassic) and lower Bullhead (Lower Cretaceous) group of formations. --Auth.

1-658. Robinson, Florence M. TEST WELL, GRANDSTAND AREA, ALASKA: U. S. Geol. Survey, Prof. Paper 305-E, p. 317-38, 7 illus. (1 in pocket), 8 tables, 1958, pub. Jan. 1959, 6 refs.

Grandstand test well 1 was the southernmost test drilled by Arctic Contractors during the exploration of Naval Petroleum Reserve No. 4 in northern Alaska. It was drilled in 1952 on the Grandstand anticline about 30 mi. S. of Umiat to test the sandstone beds of Early Cretaceous age for the presence of petroleum.

It was found that the objective sandstone present on the outcrop at Tuktu Bluff to the S. grades to siltstone and clay shale at this location on the Grandstand anticline and that the thousand feet of shallower sandstone (Grandstand and Chandler formations) penetrated has very low porosity and permeability. No oil or gas was found.

This report includes stratigraphic, paleontologic, logistic, and engineering data obtained in the drilling of the test. Much of the information is presented on a graphic log. --Auth.

With section: Micropaleontogic study of Grandstand test well 1, northern Alaska, by Harlan R. Bergquist.

1-659. Collins, Florence Rucker. TEST WELLS, MEADE AND KAOLAK AREAS, ALASKA: U. S. Geol. Survey, Prof. Paper 305-F, p. 341-76, 9 illus. (2 in pocket), 6 tables, 1958, pub. Jan. 1959, 3 refs.

The Meade and Kaolak test wells were drilled in 1950 and 1951 as part of the petroleum exploration program carried on by the U. S. Navy in Naval Petroleum Reserve No. 4, northern Alaska. The wells tested Cretaceous rocks on anticlines defined by seismograph surveys in the western part of the Arctic coastal plain, in areas hitherto little known geologically. Both were abandoned as dry holes, although Meade test well 1 produced a small amount of gas. Both tests penetrated beds of the Nanushuk group. In Meade test well 1 the Nanushuk group includes both marine and nonmarine sandstone and shale, and some coal. In Kaolak test well 1 the Nanushuk group consists of an almost completely nonmarine sequence which contains abundant coal. The sequence underlying the Nanushuk group in both wells is composed primarily of marine shale assigned to the Topagoruk formation in the Meade well and tentatively so correlated in the Kaolak well.

This report contains lithologic, paleontologic, logistic, and engineering information obtained in drilling the tests; much of the data are presented graphically. --Auth.

With section: Micropaleontology of Meade test well 1 and Kaolak test well 1, northern Alaska, by Harlan R. Bergquist.

1-660. Osipova, A. I. O SPORNYKH VOPROSAKH STRATIGRAFII NIZHNIKH GORIZONTOV PALEOGENA YUGO-VOSTOKA SREDNEY AZII [DEBATABLE QUESTIONS OF STRATIGRAPHY OF LOWER PALEOGENE HORIZONS OF THE SOUTHEASTERN PART OF CENTRAL ASIA]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 93-108, table, 39 refs.

The author is concerned with determining the stratigraphic position of a transition horizon in the Tadzhik depression, which separates the Bukhara formation (Paleocene epoch) and Suzak (Eocene epoch). She sums up the works (very often contradictory) of the following geologists and paleontologists: O. S. Vyalov, A. M. Gabrilyana, S. N. Simakov, O. M. Varetsova-Manuylenko, V. T. Balakhmatova, N. K. Bykova, L. V. Mironova, V. I. Solun, N. I. Chernyak, B. A. Petrushevskiy, R. F. Gekker, T. N. Belskaya, A. A. Vorobyev, and Ye. V. Liverovskaya. According to O. S. Vyalov, the most exact indication of which epoch this horizon belongs to is given by various species of oysters found in it. The author comes to the conclusion that the middle beds of the Tadzhik depression [39°N. 71°E.], characterized by the presence of the species of oysters Gryphaea antiqua (Schwetz), belongs to the Bukhara formation. --LC.

1-661. Zaklinskaya, Ye. D. PRINTSIPY PALEOFLORISTICHESKOGO OBOSNOVANIYA RASCHLENENIYA KAYNOZOYSKIKH OTLOZHENIY KAZAKHSTANA I PRILEGAYUSHCHIKH CHASTEY ZAPADNO-SIBIRSKOY NIZMENNOSTI [THE PRINCIPLES OF PALEOBOTANICAL METHODS OF ZONATION OF THE CENOZOIC DEPOSITS OF KAZAKHSTAN AND ADJACENT PARTS OF THE WEST SIBERIAN LOWLAND]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 72-85, 12 maps, 2 diags., 2 tables, 29 refs.

The author stresses the importance of determining the connection between the fossil flora and the formations formed during different stages of the Cenozoic era. The study of spores and pollen found in the Cenozoic of Kazakhstan [48°N. 62°E.] and West Siberia showed the evolution of climatic conditions in that region from sub-tropical in Paleocene-Eocene time to temperate during the present time. The following geologists and paleontologists are mentioned for their contributions to this study: A. L. Yanshin, K. V. Nikiforova, N. K. Ovechkin, V. V. Lavrov, Ye. P. Boytsova, S. B. Shatskiy, V. S. Kornilova, L. N. Rzhannikova, L. Yu. Budantsev, A. G. Kovalevskaya, G. A. Baluyeva, A. N. Krishtofovich, V. P. Grichuk, V. I. Baranov, V. Sukhov, M. G. Gorbunov, A. A. Larishchev. --LC.

5. PALEONTOLOGY

See also: Geologic Maps 1-622; Stratigraphy 1-653, 1-656 through 1-661.

1-662. Amsden, Thomas W., and W.E. Ham. A REMARKABLE SPECIMEN OF THE TRILOBITE ISOTELUS FROM THE VIOLA LIMESTONE: Oklahoma Geol. Survey, Oklahoma Geology Notes, v. 19, no. 2, p. 18-19, illus., Feb. 1959, 3 refs.

Complete articulated specimens of Isotelus are uncommon. The specimen described, from the lower part of the Middle Ordovician Viola limestone, Coal County, Oklahoma, is unusually large and well preserved. It is 8 in. long with the anterior portion of the cephalon missing; when complete, it must have measured 9 in. It is 5 in. wide at the posterior end of the cephalon. A considerable portion of the original skeleton is preserved, but both eye lobes are broken.

Some comparisons are made with I. gigas Dekay from the Trenton limestone of New York, I. iowensis Owen and I. maximus Locke. A more representative Viola collection is needed before more precise identification can be made. --A. C. Sangree.

1-663. Langston, Wann, Jr. CHAMPSOSAUR GIANTS: Canada, Natl. Mus., Nat. History Papers, no. 2, 4 p., fig., Aug. 1958.

Some Paleocene and Eocene representatives of the late Cretaceous and early Tertiary reptilian suborder Choristodera in North America and Europe attained a size appreciably larger than earlier members of the group. This suggests a tendency toward gigantism among champsosaurs paralleling trends seen elsewhere in various reptile groups as these approached extinction. --Auth.

1-664. Russell, Loris S. A HORSE ASTRAGALUS FROM THE HAND HILLS CONGLOMERATE OF ALBERTA: Canada, Natl. Mus., Nat. History Papers, no. 1, 3 p., 2 figs., Aug. 1958.

Apparently unfossiliferous conglomerate of supposed Oligocene or Miocene age on the summit of the Hand Hills of Alberta has yielded the astragulus of an advanced horse, probably Plesippus, but possibly Hypohippus. On this basis the deposit is tentatively dated as late Pliocene. --Auth.

1-665. Blow, Walter H. AGE, CORRELATION, AND BIOSTRATIGRAPHY OF THE UPPER TOCUYO (SAN LORENZO) AND POZÓN FORMATIONS, EASTERN FALCÓN, VENEZUELA: Bulls. Am. Paleontology, v. 39, no. 178, p. 67-251, 4 maps (1 fold.), 4 charts (1 fold., 1 in pocket), pls. 6-19, Feb. 1959, 104 refs.

H. H. Renz (1948) proposed a biostratigraphical subdivision of the Agua Salada group, eastern Falcón, Venezuela [11^{o}N., 69^{o}50'E.], based almost entirely on the occurrence of benthonic Foraminifera. The present work critically re-examines this biostratigraphy in the light of new evidence from a detailed traverse along the Pozón-El Mene road. The stratigraphical distribution of both benthonic and planktonic Foraminifera has been investigated. Evidence from this traverse shows that a direct correlation between the planktonic foraminiferal biozones used in Trinidad and the subdivisions of Renz can be achieved. Furthermore, whereas, in southern Trindad, Miocene sediments above the Globorotalia menardii zone, Lengua formation, are devoid of planktonic Foraminifera, corresponding sediments in eastern Falcón often contain abundant planktonic faunas. Investigations show that, using planktonic Foraminifera, a further subdivision of these higher sediments is possible. Three new biozones are proposed within these middle to upper Miocene sediments.

Since the section in eastern Falcón is largely undisturbed by tectonic complications, a confirmation of H. M. Bolli's (1950, 1957) planktonic zonation based on surface and subsurface sections within the Cipero-Lengua formations (southern Trinidad) is possible. Bolli's biozones are shown to have more than local validity whereas the benthonic foraminiferal zonation of Renz is strongly influenced by ecological conditions.

The age and a trans-Atlantic correlation of these eastern Falcón Miocene sediments is discussed in the light of evidence seen recently in Sicily and Malta.

A number of evolutionary studies have been made within the Oligocene and Miocene Orbulinidae and Globorotaliidae, and 5 lineages have been distinguished and are discussed. In some of these lineages, evolutionary changes appear to have occurred in a repetitive manner. The first occurrence and evolution of Globigerina bulloides is discussed. Reference is also made to the evolution and first occurrence of the genus Orbulina d'Orbigny, whilst the wall structure and morphology of the genus Sphaeroidinella Cushman, 1927, is discussed in some detail.

One hundred seventy-four species of benthonic Foraminifera (including 2 new species) and 72 species or subspecies of planktonic Foraminifera (including 10 new forms) are described or discussed.

The name Tocuyo is substituted for San Lorenzo, a term which is preoccupied by the name San Lorenzo formation in California (Arnold, 1906). --Auth.

1-666. Hass, Wilbert H. CONODONTS FROM THE CHAPPEL LIMESTONE OF TEXAS: U. S. Geol. Survey, Prof. Paper 294-J, p. 365-99, 6 illus., 2 tables, Feb. 1959, 47 refs.

The Chappel limestone of Early Mississippian (late Kinderhook and probably partly early Osage) age crops out in the Llano region of Texas where it is as much as 45 ft. thick. It contains 3 conodont faunal zones which, from youngest to oldest, are herein designated: (1) the Bactrognathus communis zone of probable early Osage age; (2) the Gnathodus punctatus zone of late Kinderhook (Chouteau) age--this zone ranges throughout the greater thickness of the Chappel; and (3) the Siphonodella cooperi zone, also of late Kinderhook (Chouteau) age. This zonation is based on an examination of the disjunct conodonts in more than 150 collections, as well as on a study of the frequency distribution of species in 68 collections. These 68 collections contain 22,946 identifiable specimens, some representing reworked material derived from Ordovician, Devonian, and lowermost Mississippian sources. Four generic names, Dollymae, Branmehla, Hindeodina, and Pandorinellina, are new; the last named replaces Pandorina Stauffer, 1940, which is preoccupied.

A new classification of disjunct conodonts is presented. This classification, utilitarian rather than biologic, is based on the fact that each individual conodont was built up by the accretion of lamellae about the apex of the pulp cavity. This cavity is used as the point of reference for all other parts of the conodont structure. Separation of the lamellae from one another, along one or more growth axes and in one or more directions, resulted in the development of fanglike structures without denticles (Distacodontidae); fanglike structures with denticles (Belodontidae); denticulated blades and bars (Coleodontidae, Prioniodinidae, and Prioniodontidae); platelike structures with platforms (Polygnathidae); and platelike structures with greatly expanded pulp cavities (Idiognathodontidae). --Auth.

1-667. Abbott, Maxine Langford. THE AMERICAN SPECIES OF ASTEROPHYLLITES, ANNULARIA, AND SPHENOPHYLLUM: Bulls. Am. Paleontology, v. 38, no. 174, p. 289-390, 5 charts, 15 pls., Dec. 1958, 104 refs.

Organ genera based on roots, stems, leaves, and fructifications of both herbaceous and arborescent sphenopsids are common in the collections of Pennsylvanian fossils. In a large part the sterile foliage may be referred to Asterophyllites, Annularia, and Sphenophyllum, and less frequently to Lobatannularia or Equisetites. There is considerable taxonomic confusion concerning these genera and this paper is an attempt 1) to re-evaluate North American species of Asterophyllites, Annularia, and Sphenophyllum; 2) to present means of their identification; 3) to determine the geological range and geographical distribution; and 4) to present some new morphological data concerning the mucro, sheath, epidermal pattern, stomata, and hairs which have been obtained by using transfer methods.

Asterophyllites and Annularia are foliage shoots of probable calamitean affinity represented by branched or simple, articulated, delicate stems bearing whorls of leaves at each articulation. These genera are similar in that they have leaves which are usually linear-lanceolate, uninerved, and more or less conspicuously united at the base. Distinctive features of the leaves of the two genera include the type of lateral margins, the width, and the position of the leaves in the whorl with relation to the axis. In Asterophyllites the leaves are of equal length, are usually cupped around the axis, while in Annularia the leaves, which are equal in length in some species and unequal in others, radiate from the node.

Determination of the individual species within the two genera is based upon details of the width-length ratio, number of leaves in a whorl, shape of the leaf, and size and position of the widest portion of the leaf. It is necessary to use a combination of characters rather than a single feature in order to separate one species from another in either genus.

The leaves of Sphenophyllum occur in verticils or whorls usually of six leaves at the articulations of the axes and do not alternate with those of the verticil below but are superposed.

The leaf varies from cuneate to elongate-oval, from more or less entire with pointed or blunt teeth to laciniate or to deeply lobed or filamentous. The kind and degree of dissection of the leaves may vary greatly from the apex to the base of the plant, but the overall pattern of leaf dissection is consistent for the species.

The leaves of each verticil form the same angle to the axis and give a radial symmetry and are usually oriented so that they lie in a plane parallel to the axis. Most of the species bear verticils of leaves of equal length but in some they are in pairs of unequal length.

Sphenophyllum is readily distinguished from Asterophyllites and Annularia by the venation of the leaf. In Sphenophyllum one vein enters the base of the leaf and undergoes one to eight dichotomies before the resulting veinlets terminate at the distal margin in the lobes or teeth.

It has been found in North America that 1) Asterophyllites includes four species, namely, Ast. charaeformis (Sternberg) Geoppert, 1884, Ast. equisetiformis (Schlotheim) Brongniart, 1828, Ast. grandis (Sternberg) Geinitz, 1855, and Ast. longifolius (Sternberg) Brongniart, 1828; 2) Annularia includes ten species, namely, Ann. acicularis (Dawson) White, 1900, Ann. aculeata Bell, 1944, Ann. disteris Bell, 1944, Ann. galioides (Lindley and Hutton) Kidston, 1891, Ann. latifolia (Dawson) Kidston, 1886, Ann. mucronata Schenk, 1883, Ann. radiata (Brongniart) Sternberg, 1825, Ann. sphenophylloides (Zenker) Gutbier, 1837, Ann. stellata (Schlotheim) Wood, 1860, and Ann. vernensis (Arnold) Abbott, 1958; and 3) Sphenophyllum includes 18 species, namely, Sph. angustifolium (Germar) Geoppert, 1848, Sph. arkansanum White 1936, Sph. cornutum Lesquereux, 1870, Sph. cuneifolium (Sternberg) Zeiller, 1880, Sph. emarginatum Brongniart, 1828, Sph. fasciculatum (Lesquereux) White, 1899, Sph. gilmorei White, 1929, Sph. lescurianum White, 1899, Sph. longifolium (Germar) Geinitz, 1843, Sph. majus Bronn, 1835, Sph. oblongifolium (Germar and Kaulfuss) Unger, 1850, Sph. obovatum Sellards, 1908, Sph. tenerrimum (Ettingshausen) Stur, 1887, Sph. tenue White, 1900, Sph. tenuifolium Fontaine and White, 1880, Sph. thoni Mahr, 1868, Sph. trichomatosum Stur, 1887, and Sph. verticillatum (Schlotheim) Zeiller, 1885. --Auth.

1-668. Wilson, L. R. GEOLOGICAL HISTORY OF THE GNETALES. Oklahoma Geol. Survey, Oklahoma Geology Notes, v. 19, no. 2, p. 35-40, pl., Feb. 1959, 27 refs.

Until the discovery of fossil Gnetales pollen the paleontological record of that order of gymnosperms was meager and restricted to the Tertiary. Fossil pollen of Ephedra and Welwitchia are here reported from the Middle Permian rocks of Oklahoma. Other Permian occurrences are in Australia, Russia, and Germany. Gnetum pollen is reported from the Oligocene of Russia but its identity is not confirmed. The fossil pollen record provides the evidence for the anticipated Paleozoic origin of the Gnetales. --Auth.

6. GEOPHYSICS

See also: Geologic Maps 1-556, 1-572, 1-573, 1-608 through 1-621; Structural Geology 1-642; Geohydrology 1-730; Engineering Geology 1-778.

1-669. Gerson, N. C. THE INTERNATIONAL (GEOPHYSICAL) YEARS - AN APPRAISAL: Franklin Inst., Jour., v. 267, no. 2, p. 135-41, Feb. 1959, 12 refs.

Evaluation of IGY returns, comparison of results with those of its predecessors, the First and Second International Polar Years, and comments on the future of International Geophysical Years are made.

A much greater number of nations, scientists, and stations participated with greater cooperation in IGY 1957-1958 than in either of the Polar Years. Some objectives in meteorology, magnetism, auroral physics, and oceanography remained unchanged. The bold emphasis of IGY on space investigations was unprecedented.

Although International Years have stimulated activity in the geophysical sciences and have contributed somewhat to their general advance, they have produced no great break-through. Most of the effort was channeled into data obtainment, and the accumulated data have remained essentially untapped. In geophysics, a shift in emphasis from data gathering to data analysis seems long overdue. --G. E. Denegar.

1-670. Odishaw, Hugh, and Stanley Ruttenberg, eds. GEOPHYSICS AND THE IGY. PROCEEDINGS OF THE SYMPOSIUM AT THE OPENING OF THE INTERNATIONAL GEOPHYSICAL YEAR: Natl. Acad. Sci.-Natl. Research Council, Pub. 590 (Am. Geophys. Union, Geophys. Mon. no. 2), 210 p., illus., 1958, refs.

The papers included in the proceedings were presented at a special symposium, June 28 and 29, 1957, conducted by the U. S. National Committee for the International Geophysical Year, just before the IGY program formally began. The papers concerned upper-atmosphere physics, the lower atmosphere and the earth, and polar regions. Contributors to the section on upper-atmosphere physics (p. 1-146) were: Walter O. Roberts, N. C. Gerson, John W. Evans, Millett G. Morgan, R. A. Helliwell, A. H. Shapley, Ralph J. Slutz, Harry W. Wells, Elliott B. Roberts, David G. Knapp, J. A. Simpson, Robert L. Chasson, E. P. Ney, J. R. Winckler, C. W. Gartlein, Franklin E. Roach, P. H. Wyckoff, Herbert Friedman, John P. Hagen, W. H. Pickering, and James A. Van Allen.

In the section, the Lower Atmosphere and the Earth, (p. 147-202), the following topics were discussed: heat and water budget of the earth, synoptic meteorology, special meteorological studies, oceanography, seasonal water budget, polar ice and snow studies, mountain glaciology, crust and mantle of the earth, seismology, and gravity observations. Contributions to this section were made by Roger R. Revelle, Morton J. Rubin, Sigmund Fritz, Columbus O'D. Iselin, Walter H. Munk, Henri Bader, George P. Rigsby, Maurice Ewing, Jack E. Oliver, and G. P. Woollard.

The U.S. IGY program in the Antarctic was outlined by Laurence M. Gould, and the Arctic counterpart by John C. Reed (p. 203-210). --G. E. Denegar.

1-671. O'Keefe, J. A., Ann Eckels, and R. K. Squires. VANGUARD MEASUREMENTS GIVE PEAR-SHAPED COMPONENT OF EARTH'S FIGURE: Science, v. 129, no. 3348, p. 565-66, graph, Feb. 27, 1959, 4 refs.

The determination of the orbit of the Vanguard satellite, 1958β_2, has revealed the existence of periodic variations in the eccentricity of that satellite, indicating the presence of a third zonal harmonic in the earth's gravitational field. The third zonal harmonic modifies the geoid toward the shape of a pear, with the stem at the North Pole.

The determination of a third-degree zonal harmonic indicates a very substantial load on the surface of the earth, calculated to be 2 x 10^7 dy./cm.^{2} Whether assuming that this stress exists down to the core of the earth or that stresses of about 4 times that amount exist in the uppermost 700 km. only, these stresses must be supported either by a mechanical strength greater than usually assumed or by large-scale convection currents in the mantle. --G. E. Denegar.

1-672. Thompson, George A. GRAVITY MEASUREMENTS BETWEEN HAZEN AND AUSTIN, NEVADA: A STUDY OF BASIN-RANGE STRUCTURE: Jour. Geophys. Research, v. 64, no. 2, p. 217-29, 5 figs. incl. map, 2 tables, Feb. 1959, 18 refs.

From the pendulum base stations at Mystic and Truckee, California, a line of gravimeter stations, with side loops, was extended eastward through Hazen, Fallon, Eastgate, and Austin, Nevada, crossing the area displaced by faults in 1954. Regionally, the Bouguer anomaly is about -160 mgal. from Hazen eastward through Fallon to the Stillwater Range. Farther E. the values decrease to -215 mgal. near Austin, a change that can be accounted for by isostatic compensation for the increase in average elevation of about 1700 ft. Low-density sedimentary and volcanic debris is abundant enough in the intermontane basins and in parts of the mountains to make the average density of the whole elevated land mass abnormally low with respect to the conventional value, 2.7 g./cc. Consequently, 10 to 15% of the compensation for this high region is in the superficial materials themselves. The Basin Ranges show no evidence of being individually compensated.

Locally, each of the basins has a negative Bouguer anomaly relative to the adjacent ranges, reflecting thick sedimentary and volcanic fill. Dixie and Fairview valleys, in the area displaced by faults in 1954, are characterized by local negative anomalies of about 30 mgal., indicating that these valleys contain several thousand feet of lightweight Cenozoic sediments and that their bedrock floors lie below sea level. The 1954 faulting is thus only the latest of many displacements that produced not only the visible topographic relief of 5000 ft. but also a buried relief of comparable magnitude.

Romney's [1957] seismic studies of the 1954 faulting and Whitten's [1957] geodetic measurements agree with direct observations of fault surfaces to indicate a horizontal extension of about 5 ft. normal to the trace of the fault. Independent of a strike-slip component of faulting, the region is expanding in area. If the total structural relief was produced by displacements comparable to that of 1954, the extension across Dixie and Fairview valleys amounts to about 1 1/2 mi. in roughly 15 million years, and if this is taken as a fair sample of the Basin and Range Province, the rate of distension in the province is about 1 ft./century, a rate well within that of historical fault displacements.

At the time of the 1954 faulting, the Bouguer gravity anomaly either did not change or decreased algebraically by an amount no greater than 1.0 mgal. --Auth.

1-673. Du Bois, P. M. PALAEOMAGNETISM AND CONTINENTAL DRIFT: Royal Soc. Canada, Trans., Sec. 4, Geol. Sci., 3d ser., v. 52, p. 17-26, 6 figs. incl. 4 maps, table, June 1958, 16 refs.

Palaeomagnetic measurements from several different continents are discussed. If the earth's magnetic field, averaged over a long period of time, is assumed to be that of a central dipole oriented along the earth's axis of rotation, then comparisons between palaeomagnetic measurements from different continents indicate that large relative movements between the continents have taken place. The basic assumption about the axial and dipolar nature of the earth's average magnetic field is theoretically reasonable and is supported by the experimental results from the Tertiary. --Auth.

1-674. Madden, Theodore R., and Donald J. Marshall. A LABORATORY INVESTIGATION OF INDUCED POLARIZATION, INTERIM REPORT FOR 1957-58: U. S. Atomic Energy Comm., [Pub.] RME-3156, 78 p., 8 figs. incl. diags., graphs, 6 tables, Aug. 1958, pub. 1959, 5 refs.

This report contains a discussion of the various experimental methods used in the induced-polarization study of rock samples. These methods include electrical measurements and mineralogical analyses for clays and sulfides.

A measurement system has been developed which can measure polarization effects of less than 1%.

Practical methods for carrying out the Fourier analysis have been worked out and frequency information at 10, 1 and .1 cycles per second has been derived from the transient measurements. These results are listed for approx. 200 rock samples from several interesting geologic areas. --Auth.

1-675. Knopoff, Leon. VELOCITY OF SOUND IN TWO-COMPONENT SYSTEMS: Jour. Geophys. Research, v. 64, no. 3, p. 359-61, 2 graphs, March 1959, 14 refs.

The velocity of sound has been measured between the liquidus and solidus temperatures in two-component systems. For high frequencies, the results show the transitions to be second order transitions. On this basis, the decrease in velocity in region F of the earth's core, reported by Jeffreys, is shown to be inconsistent with the assumption of a simple Fe-Ni composition for both the solid inner and liquid outer cores. --Auth.

1-676. Oliver, Jack E. LONG EARTHQUAKE WAVES: Sci. American, v. 200, no. 3, p. 131-43, figs., graphs, March 1959.

All major earthquakes are associated with rupturing of rock in the crust or the mantle. The rupturing process is limited in space and time, yet it excites vibrations in a wide spectrum of wavelengths throughout the earth. From the shorter-period seismic waves that travel through the interior of the earth, the compression (P) wave and shear (S) wave, we have learned much about the structure of the earth. Two long-period surface waves are also transmitted. During the passage of the Love wave the ground vibrates horizontally at right angles to the direction of the wave; when the Rayleigh wave passes a point on the surface, the point moves around an ellipse in a direction parallel but opposite to the direction of the wave.

Surface waves reaching the seismological observatory are characteristically long. As the inertial seismometer works well only for those waves that are shorter than its own period of oscillation, only a few observatories are equipped to record the long or surface waves.

Waves of different lengths become vehicles for information about the rock through which they pass. Although Love and Rayleigh waves are confined to the surface, they probe a depth that depends on their length. The record of arrival times of waves of different length help make it possible to compute velocities which provide a measure of the elasticity and density of rock.

Waves long in both time and space begin to verge on the dimensions of the free oscillations of the earth itself. Three major types of oscillations, each with an infinity of higher modes of increasing complexity, are possible in a homogeneous sphere undergoing free vibration due to elastic and gravitational forces. The theoretical calculation of one of these possibilities coincides with the longest-recorded, 3,400-second wave. The long waves lack the resolving power to enable us to learn much from them about the interior of the earth. However, the higher-mode harmonics of the free oscillations should possess the needed resolving power. --G. E. Denegar.

1-677. Tocher, Don, and Don J. Miller. FIELD OBSERVATIONS ON EFFECTS OF ALASKA EARTHQUAKE OF 10 JULY 1958: Science, v. 129, no. 3346, p. 394-95, illus., Feb. 13, 1959, 5 refs.

The Alaska earthquake of 10 July 1958 was caused by movement on the Fairweather fault amounting to at least 21 1/2 ft. horizontally and 3 1/2 ft. vertically. Effects of strong shaking were evident over a large area in southeastern Alaska. In Lituya Bay, an enormous wave, possibly resulting from a rockslide, reached a maximum height of more than 1700 ft. --Auth.

1-678. Stewart, J. W. THE EFFECTS OF EARTHQUAKES ON WATER LEVELS IN WELLS IN GEORGIA: Georgia Mineral Newsletter, v. 11, no. 4, p. 129-31, fig., Winter 1958, ref.

Distant earthquakes cause water levels in "sensitive" wells in Georgia to fluctuate. These fluctuations are recorded by float-actuated recording gages, a function incidental to the recording of changes in water levels significant to the development and use of ground water.

The amount of water-level fluctuation in a well caused by an earthquake shock depends on distance, local geologic conditions, magnitude of the earthquake, type of earth movement causing the shock, depth of earthquake focus, types of waves generated, and construction of wells. Ordinarily earthquake shocks are recorded in artesian wells because artesian aquifers are elastic. In a water-table well the compressional effect is not registered unless impermeable material causes local confinement of water, producing an artesian effect. The water-level fluctuations are significant in hydrologic studies because they disclose the occurrence of impermeable zones which otherwise may not be known. --G. E. Denegar.

1-679. Stewart, J. W. EARTHQUAKE HISTORY OF GEORGIA: Georgia Mineral Newsletter, v. 11, no. 4, p. 127-38, Winter 1958, 3 refs.

The eastern United States is a region of frequent but generally moderate earthquake shocks. Georgia has felt strongly a number of earthquakes occurring outside its borders. Five earthquakes having epicenters in Georgia have had an intensity on the Rossi-Forel scale of 6 to 7 (strong shocks). Twenty-one earthquakes, originating or felt in Georgia since 1811, are listed chronologically with locality and descriptive remarks. The last reported earthquake felt in the State occurred in Dec. 1947. --G. E. Denegar.

1-680. Aronovich, Z. I. O POGRESHNOSTYAKH PRI OPREDELENII KOORDINAT KRYMSKIKH ZEMLETRYASENIY [ON THE ERRORS OF DETERMINING THE COORDINATES OF EARTHQUAKES IN THE CRIMEA]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 255-59, 4 figs., 4 tables, 6 refs.

The author investigated the problem of determining errors when utilizing the method of intersection for locating the foci of nearby (less than 100 km. distant) earthquakes... The following general conclusions were derived relating to the evaluation of errors in determining the coordinates of Crimean earthquakes: the range of possible errors increases with increasing distance of the epicenters of earthquakes SE. of Yalta [45°30'N. 34°10'E.]; there is a greater likelihood of the determined epicenter being displaced from the real one in latitude than in longitude, and this is due to the unilateral distribution of the existing seismic stations relative to the epicenter zone; on displacement of the epicenters from the line Yalta-Simferopol, the larger axis of the ellipse of the range of errors turns clockwise; the method of intersection leads to considerable errors when determining the depth of tremors in the Crimea, particularly in the case of tremors of low intensity. It is pointed out that fitting new "regional" apparatus into Crimean seismic stations, increasing the speed of the recording to 60 mm./min., and putting into operation a seismic station in Alushta [44°40'N. 34°25'E.] provided in recent years more favorable conditions for increased accuracy in determining the coordinates of the foci of earthquakes in the Crimea. --LC.

1-681. Karapetyan, N. K. DINAMICHESKIYE PARAMETRY OCHAGOV NEKOTORYKH ZEMLETRYASENIY KAVKAZA [DYNAMIC PARAMETERS OF THE FOCI OF SOME EARTHQUAKES IN THE CAUCASUS]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 260-268, 9 figs., 2 tables, 7 refs.

Keylis-Borok developed a method of studying processes taking place in foci of earthquakes, based on investigating the shape and intensity of the seismic tremors. He evolved a mathematical model of the focus in the form of a point source which, if placed into the focus of the earthquake, would produce at the points of observation equal vibrations. The medium in which the studied waves propagate (between the focus and the stations) must be uniform, isotropic, and ideally elastic, and the linear dimensions of the focus should be small compared with the hypocentral distance and the wavelength. The foci are assumed as corresponding to various point sources. This method of determining the dynamic parameters of the focus of an earthquake permits establishing the character, magnitude, and direction of the forces acting in the focus and, consequently, also of the orientation of the surface along which a displacement or a movement of the parts of the Earth's crust takes place. The dynamic method is used by the author for interpreting seismic observations of earthquakes in the Caucasus. The investigation is based on a selection of 10 earthquakes for which a sufficiently detailed recording of the tremors is available. --LC.

1-682. Vvedenskaya, N. A. OB ISPOLZOVANII INSTRUMENTALNYKH NABLYUDENIY NAD SLABYMI ZEMLETRYASENIYAMI PRI SEYSMICHESKOM RAYONIROVANII [ON UTILIZING OBSERVATIONS WITH INSTRUMENTS OF WEAK EARTHQUAKES DURING SEISMIC ZONING]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 210-24, 5 figs., 6 tables, 10 refs.

On the basis of analysis of observations of turbulent seismic stations of earthquakes in Central Asia between 1950 and 1955, an attempt is made to establish the relation between the distribution of tremors of weak and strong earthquakes and to solve the problem on the possibility of utilizing the territorial distribution of weak earthquakes in seismic zoning. Analysis of this data as well as the data of stronger earthquakes during earlier periods and of results published by other Soviet authors leads to the conclusion that there is a territorial link between the distribution of the foci of weak earthquakes during recent years with the distribution of foci of strong earthquakes over longer periods. This permits utilizing data collected on weak earthquakes during recent years for seismic zoning aimed at outlining individual epicenter regions and seismically active zones. However, in compiling charts of seismic zoning, it is necessary to outline not only the contours of the epicenter zones but also to determine the maximum intensities of these zones. --LC.

1-683. Malinovskaya, L. N. O DINAMICHESKIKH OSOBENNOSTYAKH POPERECHNYKH VOLN PRI POLNOM VNUTRENNEM OTRAZHENII [ON THE DYNAMICAL PROPERTIES OF TRANSVERSE WAVES TOTALLY INTERNALLY REFLECTED]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 184-95, 11 figs., 2 refs.

The effect of a free surface on the form, polarization, and the ratio of the components of displacement of a transverse wave are considered for direct waves as well as for waves which have experienced a number of reflections and refractions along their path. The effect of a surface layer moving with low speed on the transverse waves, which are incident on the base of the layer at an angle greater than the critical angle, is discussed. The work was carried out in connection with problems of phase recognition, determination of exit angles, and the exclusion of the effect of interfaces. The vertical and horizontal components of the displacements can only differ in form for a transverse wave and only in the case when this wave is incident on a free surface at an angle greater than the critical angle. All the possible ratios of the components (for the special case $a_o/b_o = 1.73$, where $\sin i_{crit} = b_o/a_o$) are shown. From this, it is possible to determine the horizontal and vertical components (q, w) of the displacement. Using the results of this paper it is possible to construct theoretical seismograms for an arbitrary value of a_o/b_o and different angles of incidence. --LC.

1-684. Ogurtsov, K. I., and A. V. Burova. OB INTENSIVNOSTYAKH PRYAMYKH PRODOLNYKH I POPERECHNYKH VOLN, RASPROSTRANYAYUSHCHIKHSYA PO GRANITSE POLUPROSTRANSTVA [ON THE INTENSITY OF DIRECT LONGITUDINAL AND TRANSVERSE WAVES PROPAGATED ALONG THE BOUNDARY OF A SEMISPACE]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 157-64, 5 figs., table, 3 refs.

Calculations of the intensity of transverse and longitudinal non-stationary waves propagated along the boundary of an ideal elastic semispace are reported for different values of Poisson's ratio, and a graph is given of the intensity of these waves as a function of V_SV_p (the ratio of the speeds of propagation of transverse and longitudinal waves). Analogous calculations have been carried out for a harmonic source and for $\sigma = 0.25$. The above problem was first considered by Lamb, and a large number of theoretical and experimental papers have been published on the subject. The authors have thought it useful to return to the problem first solved by Lamb in order to calculate and compare intensities of longitudinal and transverse waves in the above case. Such calculations and comparisons have been carried out by Kosminskaya, although her calculations apply only to the special case of a harmonic oscillator and $\sigma = 0.25$, as mentioned above. The authors consider that the method given in this paper is convenient because of the possible physical interpretation. Using the simple formulae which constitute the solution of Lamb's problem for the unit step function source defined by:

$$\epsilon\ (t) = \begin{cases} 0 & t < 0 \\ 1 & t > 0, \end{cases}$$

it is possible to construct theoretical seismographs for any distance from the source for any value of V_S/V_p which depends on Poisson's ratio as given by the relation:

$$\gamma = \sqrt{\frac{1 - 2\sigma}{2(1 - \sigma)}}.$$

If the wavelengths of the waves are sufficiently small compared with the distance of the given point from the source, then the intensities I_S and I_p on the wave fronts of transverse and longitudinal waves can be determined. A table gives these functions in terms of elastic constants and densities. The ratio of these intensities I_S/I_p [is shown] plotted as a function of V_S/V_p. Roughly speaking, the latter curve falls off exponentially. This ratio (I_S/I_p) can be as large as we please for $\sigma \sim 0.5$ and as small as we please for $\sigma \sim 0$. --LC.

1-685. Blaik, M., J. Northrop, and C. S. Clay. SOME SEISMIC PROFILES ONSHORE AND OFFSHORE LONG ISLAND, NEW YORK: Jour. Geophys. Research, v. 64, no. 2, p. 231-39, 8 figs. incl. map, Feb. 1959, 17 refs.; also pub. as: Columbia Univ., Hudson Labs., Contr. no. 26.

Seismic-velocity determinations in shallow layers (less than 2000 ft. deep) have been made recently at an experimental location on the Atlantic Coast. Two reversed refraction profiles were obtained offshore. An unreversed refraction profile was completed on the beach. Reflection profiles were obtained both on the barrier beach and in the adjoining lagoon. Speed layering indicated by seismic reflection and refraction is compared with borehole velocity measurements. Significant thin high-speed and low-speed layers are shown by the borehole velocity data but not by the seismic profile data. The calculations from the reflection and refraction shooting show reasonable agreement with the results of the borehole velocity survey for thick layering. --Auth.

1-686. Bunker, C. M., and H. C. Hamontre. A COMPARISON AMONG CALIPER-LOG, GAMMA-RAY-LOG, AND OTHER DIAMOND-DRILL-HOLE DATA: U. S. Geol. Survey, Bull. 1052-G, p. 241-55, 2 illus., 3 tables, March 1959.

To obtain comparative data on the variation in gamma-ray intensity accompanying possible variation in the diameter of small-diameter diamond-drill holes, 6 drill holes in the Jo Dandy area, Montrose County, Colorado, were caliper logged using a well-bore caliper developed by the U. S. Bureau of Mines. The caliper logs show that within radioactive-ore zones the variation in drill-hole diameter is insufficient to cause significant variation in the gamma-ray logging measurement, that with increasing particle size in the ore-bearing sandstone the drill-hole diameter tends to increase slightly, and that with increase in hole diameter the core recovery tends to decrease slightly. --Auth.

1-687. Kogan, R. M. NEKOTORYYE INTEGRALNYYE ZAKONOMERNOSTI RASPREDELENIYA GAMMA-POLYA V SLOISTYKH SREDAKH [SOME INTEGRAL REGULARITIES IN THE GAMMA-FIELD DISTRIBUTION IN LAMINATED MEDIA]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 225-34.

In real conditions, geological formations often occur in the form of extended layers. The γ-field distribution in a system of such layers is best discussed in terms of a model such as a laminated medium. The following assumptions are made: (1) γ-rays interact with atoms or elementary particles in the substance so that these may be considered as the centers of interaction of the γ-rays with the substance; (2) the absorbing medium is taken as an ensemble of centers of interaction of a given kind, the volume density of which is described by some function of space coordinates; (3) between successive interactions of a γ-ray its trajectory is a section of a straight line; (4) the full trajectory of the γ-ray in the absorbing medium may be taken as a broken straight line. On the basis of the simple assumptions about the interaction of γ-rays with matter, properties of γ-ray trajectories are established as well as properties of integral parameters of the γ-field for a point source in laminated media. Expressions are derived which can be used to calculate for a laminated medium the integral parameters of point, volume, and plane-distributed sources from known angular spectral characteristics of a γ-field for a point source in a uniform medium. An estimate is made of "secondary effects" such as the formation of Compton electrons, photoelectrons, etc. The regularities established can be used in aerial γ-surveys and similar work. --LC.

1-688. Peters, B. PROGRESS IN COSMIC RAY RESEARCH SINCE 1947: Jour. Geophys. Research, v. 64, no. 2, p. 155-73, 3 tables, Feb. 1959, 15 refs.

Cosmic-ray physics, which 10 years ago was a fairly specialized branch of science, has in the course of its recent development become closely linked with many other fields of research. It has become an integral part of astrophysics, radioastronomy, and solar physics; it has made important contributions to such diverse fields as geomagnetism, hydrology, and archeology, and has begun to gain some importance in the study of meteorites and of oceanography and meteorology. It has also given rise to one of the newest and most active branches of physics, "particle physics," and has thereby provided the impetus for designing the large and powerful particle accelerators which are now in operation or under construction in various parts of the world. This paper is a survey of the most important developments which have taken place in cosmic-ray physics during the last decade.

The principal technical advances which have exerted decisive influence on cosmic-ray research are the development of large stratosphere balloons, of nuclear emulsions, and of radio telescopes, as well as the great progress made since the war in radio chemistry and in low-level beta- and gamma-ray counting.

The 3 sections following the introduction discuss how, with the help of these and other techniques, the nature of the primary cosmic-ray particles was determined and how a connection was established between cosmic-ray effects and astrophysical and solar phenomena. The next section deals with largely successful efforts which have been made to understand the complicated chain of processes by which the energy carried by primary cosmic-ray particles entering from outer space is first distributed over a great variety of new stable and unstable particles and finally is dissipated within the atmosphere. The 2 following sections treat the discovery of stable and radioactive isotopes which are produced during the passage of cosmic radiation through the atmosphere and contain a short review of the application which these isotopes have found in other branches of science. The last section contains a brief discussion of still unsolved problems which have now become accessible because of more recent technical advances such as satellites, permanent polar stations, and synoptic cosmic-ray observations during the International Geophysical Year. --Auth.

7. GEOCHEMISTRY

See also: Geomorphology 1-636; Geophysics 1-675, 1-688; Sedimentary Petrology 1-725; Geohydrology 1-730; Mineral Deposits 1-743, 1-744, 1-745, 1-750, 1-751, 1-752; Fuels 1-768; Miscellaneous 1-799.

1-689. Mason, Brian. PRINCIPLES OF GEOCHEMISTRY: 2d ed., 310 p., 48 figs., 44 tables, New York, John Wiley & Sons, Inc., 1958, approx. 170 refs.

This is the second edition of a textbook for a one-semester course in geochemistry at the graduate and advanced undergraduate level. It summarizes the significant facts and ideas concerning the chemistry of the earth and synthesizes these data into a coherent account of its physical and chemical evolution. The first chapter describes the scope and subject matter of geochemistry and gives a brief account of its development. The next chapter deals with the earth as a planet and its relationship to the solar system and universe as a whole, and is followed by one discussing the internal structure of the earth and its composition. From the data in these chapters an account is given of the relative abundances of the elements and isotopes, both in the earth and in the universe as a whole, and the pre-geological history of the earth is discussed. The geochemistry of igneous rocks is then dealt with, followed by a chapter on sedimentation and sedimentary rocks. The following chapters deal in turn with the geochemistry of the hydrosphere, the atmosphere, and the biosphere. The geochemistry of the hydrosphere is essentially the geochemistry of sea water and poses such fundamental questions as the mode of origin and evolution of the ocean. The geochemistry of the atmosphere is concerned with the nature of the primeval atmosphere and the changes it has undergone through interaction with the hydrosphere, the biosphere, and the lithosphere. The chapter on the biosphere includes a discussion of the amount of organic matter, its composition, and the role of organisms in the concentration and deposition of individual elements. Then follows a chapter on metamorphism and metamorphic rocks, and the final chapter is a brief summary and synthesis in terms of the geochemical cycle. A selected and annotated bibliography is appended to each chapter. --Auth.

1-690. Hill, V. G. THE APPLICATION OF WHITE SPIRIT IN FIELD DITHIZONE COLORIMETRY: Econ. Geology, v. 54, no. 2, p. 310-12, table, March/Apr. 1959, 3 refs.

White spirit (mineral turpentine) has been investigated as a solvent in field dithizone colorimetry and found to be quite suitable. The difference in the solubility of the copper dithizonate from the lead and zinc dithizonates at a pH of 8.5 can be used to distinguish the presence of these metals. --Auth.

1-691. Holland, Heinrich D. SOME APPLICATIONS OF THERMOCHEMICAL DATA TO PROBLEMS OF ORE DEPOSITS. I. STABILITY RELATIONS AMONG THE OXIDES, SULFIDES, SULFATES AND CARBONATES OF ORE AND GANGUE METALS: Econ. Geology, v. 54, no. 2, p. 184-233, 45 figs., table, March/Apr. 1959, 23 refs.

The problem of mineral association and mineral paragenesis in ore deposits has been the subject of much discussion. The attempts at a rational explanation have, however, been largely unsuccessful since they were not based on sound physical-chemical principles. A new attempt is made in this paper, and it is shown that the temperature and the fugacity (f) of O, S and Co_2 in ore-forming fluids at the time of deposition of the vein minerals largely control the mineralogy of ore deposits. fs_2-fo_2-T diagrams showing the stability fields of sulfides, oxides, and sulfates of 19 metals are developed as well as fs_2-fo_2-fco_2 diagrams showing the stability of these compounds and of carbonates of the respective elements. The diagrams are based on recent compilations of thermochemical data; they are used in the second paper of this series to define the approximate composition of ore-forming fluids and the relationships between temperature, pressure, and mineralogy in hydrothermal ore deposits. --Auth.

1-692. Rosholt, John N., Jr. NATURAL RADIOACTIVE DISEQUILIBRIUM OF THE URANIUM SERIES: U. S. Geol. Survey, Bull. 1084-A, 30 p., 4 illus., 2 tables, Feb. 1959, 19 refs.

Many radioactive samples show radioactive disequilibrium because of the numerous geochemical processes affecting ore deposits. As it is difficult to interpret disequilibria by simply comparing radiometric and chemical assay values of U, analyses should be made of the abundance of Pa^{231}, Th^{230}, Ra^{226}, Rn^{222}, and Pb^{210}.

U-series disequilibria, as shown by radiochemical studies of samples representing a cross-section of most of the significant present-day radioactive deposits in the United States, can be classified according to 6 basic types. Interpretations of the geochemical history of these types indicate that it may be possible to date U deposition within a theoretical range of 2,000 to 200,000 years. Ages ranging between 6,000 and 30,000 years have been calculated for several specific samples. --Auth.

1-693. Yershova, Z. P., and Ya. I. Olshansky. EQUILIBRIUM OF TWO LIQUID PHASES IN FLUORSILICATE SYSTEMS CONTAINING ALKALI METALS: Geochemistry [Geokhimiya], 1958, no. 2, p. 189-202, 13 diags., 8 tables, 6 refs.

1) The boundary of the region of 2 liquid phases in the system of CaF_2-Na_2O-SiO_2 has been established.

2) The boundaries of the regions of 2 liquid phases in the systems: MgF_2-NaF-SiO_2, CaF_2-NaF-SiO_2, SrF_2-NaF-SiO_2, BaF_2-NaF_2-SiO_2, MgF_2-KF-SiO_2, CaF_2-KF-SiO_2 have been established. The area of the immiscibility regions increases with the decrease of the ratio of the cation radius to valency.

3) The boundaries of the regions of immiscible liquids in the system CaF_2, CaO-Na_2F_2, Na_2O-SiO_2 have been established, O^{2-} partly being replaced by OH^-.

4) The suggestion has been made that the system formed by SiO_2 and fluorides of metals model such aqueous silicate melts in which, owing to the interaction with water at high pressures, all the O^{2-} are replaced by OH^-. --Auth. conclusions.

1-694. Ellis, A. J. THE SOLUBILITY OF CARBON DIOXIDE IN WATER AT HIGH TEMPERATURES: Am. Jour. Sci., v. 257, no. 3, p. 217-34, 6 figs., 9 tables, March 1959, 26 refs.

There are few results available in the literature for the solubilities of gases in water over 100°C., and for the geologically important gas, carbon dioxide, there is no information. In this paper the presentation and interpretation of high-temperature gas solubilities is discussed, and values are reported for the solubility of carbon dioxide in water up to 350°C. The anomalous behavior of water compared with other liquids as a solvent for gases is reviewed briefly.

Extrapolation of solubility data from low temperatures can be completely misleading unless it is realized that gas solubility coefficients pass through minimum values, usually in the temperature range 70° to 200°C. --Auth.

1-695. Arnold, James R. GAMMA RAY SPECTROSCOPY OF THE MOON'S SURFACE (In: LUNAR AND PLANETARY EXPLORATION COLLOQUIUM, OCT. 29, 1958, PROCEEDINGS, v. 1, no. 3): North American Aviation, Inc., Missile Div., Downey, Calif., Pub. 513W3, p. 28-31, [1958?].

There are only 3 elements in nature which produce radioactive energy in any real abundance. These are K, Th, and U. They are responsible for the bulk of the radioactive heat generated in the earth and, presumably, in a body similar to the earth.

These elements emit gamma rays, the scintillation-counting rate of which is roughly equal. It is possible, but difficult, to distinguish between gamma rays emitted by K, Th, and U. Also, most gamma rays of this energy do not suddenly give up all their energy. Despite these complications, in a few hours one could accumulate enough information, either from a lunar satellite or from local surface instruments, to get an idea of the composition of these 3 quite important elements.

Other reservations applying to the possibility of measuring these 3 elements include a possible radiation belt and the presence of Rn. --G. E. Denegar.

1-696. Brown, Harrison. CHEMICAL RESOURCES ON THE MOON (In: LUNAR AND PLANETARY EXPLORATION COLLOQUIUM, OCT. 29, 1958, PROCEEDINGS, v. 1, no. 3): North American Aviation, Inc., Missile Div., Downey, Calif., Pub. 513W3, p. 10-11, [1958?].

Enrichment of certain elements is brought about by 4 or 5 kinds of processes. These involve magmatic differentiation, hydrothermal activity, weathering and sedimentation, and biology. It is agreed that the last 2 do not play a major role on the moon. It is highly unlikely that the moon has a crust similar to the earth's, with a high concentration of granite. The composition of the lunar outer material might be essentially that of ultrabasic rock. Conditions favorable for elemental enrichment on earth would not be common on the moon. Ni-Fe should be found there, but it would probably be uneconomical to transport it back to the United States. --G. E. Denegar.

1-697. Urey, H. C. THE CHEMISTRY OF THE MOON (In: LUNAR AND PLANETARY EXPLORATION COLLOQUIUM, OCT. 29, 1958, PROCEEDINGS, v. 1, no. 3): North American Aviation, Inc., Missile Div., Downey, Calif., Pub. 513W3, p. 1-9, 4 illus., [1958?].

The moon is as old as the solar system. It may have been a completely melted moon initially, with radioactive elements either concentrated at the surface or distributed throughout; it may have been an initially cold moon with all the radioactive elements uniformly distributed; or it may have had another initial form.

The density of the moon is approximately 3.34 g./cc. It may be a sample of the non-volatile fraction of cosmic matter, including in its composition everything except the inert gases, H, most of the water expected, C lost as methane, N lost as a volatile substance, etc. The presence of the rest of the elements can be expected.

The surface of the moon has been much influenced by the bombardment of meteorites, rather than by the tectonic and erosional processes which mold the earth's crust. Substantial amount of Ni-Fe should be found on the surface. The craters and mountains, creating extremes in relief, are not evened in an attempt for isostatic equilibrium. However, some of the relief is less acute. This may be due to large accumulations of finely-divided rock material or dust, or possibly large flows of lava.

Black areas may be due to an admixture of graphite, and gray material may be dust; no suggested identification is offered for the white material on the moon's surface. There are probably no important large deposits of granite and basalt. Oxidized materials are probably present in small quantities, if a temporary water atmosphere subjected to the light of the sun existed at any time. --G. E. Denegar.

1-698. Thornton, Charles P. METEORITES: Mineral Industries, v. 27, no. 6, p. 1, 4-6, 8, 4 illus., March 1958.

A general, semitechnical review of the types, relative abundance, origin, and age of meteorites and a discussion of meteorite craters, based on a review of the literature. Meteorites are defined as solid particles of extraterrestrial origin, of interest to astronomers as samples of the material of interplanetary space and to geologists as rock types unknown in the earth's crust.

Meteorites are divided into 3 classes on the basis of their content of a native Ni-Fe alloy. The siderites are composed largely of this alloy and are divided into 3 types on the basis of its crystallinity: octahedrites, hexahedrites, and ataxites. Three types of alloy are described: kamacite with less than 6% Ni, taenite with more than 6% Ni, and plessite, an intergrowth of kamacite and taenite. The siderolites, the second class, are meteorites that contain considerable amounts of silicate minerals in addition to the Ni-Fe alloys. These form a link between the siderites and the third class, the aerolites, which are composed largely of silicate minerals. Two types of aerolites, chondrites and achondrites, are described.

The relative abundance of these classes of meteorites is uncertain because of the probable bias in our samples. Siderites are more easily recognized than aerolites and have been exploited as sources of Fe by early civilizations. Based on the numbers that have been observed to fall, the ratio of siderites:siderolites:aerolites is about 5:1 1/2:93 1/2. Meteorites are formed under conditions of O deficiency and high pressures; they are probably fragments of a disintegrated planet that had a structure similar to that of the earth. --Auth.

1-699. Borovik-Romanova, T. F., and E. D. Kalita. CESIUM-RUBIDIUM MICROCLINE-PERTHITE AND ITS RARE ALKALI METAL CONTENT: Geochemistry [Geokhimiya], 1958, no. 2, p. 141-50, photomicrograph, 2 graphs, 4 tables, 11 refs.

The Li, Rb, and Cs contents of microcline-perthites of the Kola peninsula, U.S.S.R. [67°20'N. 37°E.], were studied using emission spectroscopy. The microcline-perthite, which is white or cream colored, developed during the magmatic stage of pegmatization and was strongly albitized during a later metasomatic stage. X-ray interplanar-distance differences between microline-perthites containing 0.1% Rb and 1.4% Rb are only in intensity and number of lines. Spectrochemical data on Li, Rb, and Cs content of these perthites are given as a function of depth (to 55.6 m.) for 17 samples. Li content is erratic and varies from 0.014% to 0.039%. Rb and Cs are present in higher concentrations than reported in other areas of the world; Rb: 1.08 - 1.6% and Cs: 0.11 to 0.14%. The mineral is therefore called a Rb-Cs microcline-perthite. A decrease of Rb content with depth is claimed, which may be ascribable to varying degrees of albitization of the microcline. Cs remains practically constant over the same depth range. The green color of amazonite is not caused by its Rb content. A table lists Li, Rb, and Cs content of 26 amazonites, microclines, and microcline-perthites from U.S.S.R., United States (Colorado), Madagascar, and Norway. --Auth.

Editorial comment, p. 150.

1-700. Gavrilova, L. K., and R. V. Turanskaya. DISTRIBUTION OF RARE EARTHS IN ROCK-FORMING AND ACCESSORY MINERALS OF CERTAIN GRANITES: Geochemistry [Geokhimiya], 1958, no. 2, p. 163-70, graph, 2 tables, 6 refs.

In the granite from the Kirovograd district, Ukraine, [48°30'N. 32°18'E.], the distribution of rare earths in the granite itself and in separate minerals has been determined. The main part of the rare earths is contained in monazite. Rare earths are also present in rock-forming minerals (biotite, microcline). In Ca-containing minerals (apatite, garnet) a higher content of rare earths has been noted. The chief part of rare earths precipitate in the final crystallization state of the melt with a decrease of the alkali concentration. --Auth.

1-701. Kalenov, A. D. GEOCHEMISTRY OF SCANDIUM IN THE SUPERGENE ZONE: Geochemistry [Geokhimiya], 1958, no. 2, p. 171-75, 3 tables, 5 refs.

The leaching of Sc from Sc-bearing minerals in the oxidation zone, observed by the author, is described. Sc is leached especially intensively from wolframite in the oxidation zone in steppe regions as well as from allanite in the outcrops on the surface. The importance of studying this phenomenon is to ascertain the manner of Sc entrance into the wolframite and allanite lattice as well as to learn to prospect for new Sc deposits. --Auth.

1-702. Katchenkov, S. M., and F. I. Flegontova. MINOR ELEMENTS IN THE BASEMENT ROCKS OF THE EASTERN PART OF THE RUSSIAN PLATFORM: Geochemistry [Geokhimiya], 1958, no. 2, p. 224-29, table, 4 refs.

Using the method of quantitative spectroscopic analysis, the determination of Sr, Ba, V, Cr, Mn, Ni, and Cu in the rocks of the base of the eastern part of the Russian platform, represented by gneisses and granites, more rarely by gabbros, norites, and other magmatic rocks, has been carried out.

The average content of the minor elements in gneisses and granite gneisses of the base is close to their content in sandy-argillaceous rocks. For this reason they may be regarded as sedimentary rocks, having been subjected to metamorphism, with inclusions of magmatic rocks, somewhat more enriched in minor elements of the Fe group. --Auth.

1-703. Rabinovich, A. V., A. N. Muraveva, and M. V. Zhdanova. MOLYBDENUM CONTENT OF CERTAIN ROCKS AND MINERALS IN THE INTRU-

SIVES OF EASTERN TRANSBAIKAL: Geochemistry [Geokhimiya], 1958, no. 2, p. 155-62, map, table.

The Mo content in investigated unaltered magmatic-rock varieties of the eastern Transbaikal ranges from 0.5 to 3 micrograms. Mo increases from older to younger units in each of the examined intrusive complexes. Low Mo contents have been noted in feldspars, in biotite and in hornblendes (from 0.5 to 1 microgram). The highest content has been established in ilmenites, magnetites, and especially in sphenes (up to 400 micrograms). --Auth.

1-704. Slepnev, Yu. S. SOME PECULIARITIES IN THE DISTRIBUTION OF LITHIUM AND RUBIDIUM IN CERTAIN GRANITOIDS OF YAKUTIA: Geochemistry [Geokhimiya], 1958, no. 2, p. 151-54, graph, 2 tables.

Data on the Li and Rb contents in some granitoids of the Yakut A.S.S.R. are presented in the article. An increase in the Li and Rb contents in case of a transition from granites and adamellites to later rocks (alaskites) is noted. The Li and Rb concentrations also increase noticeably if later processes (greisenization) are superimposed on the rock. --Auth.

1-705. Wright, H. D., J. J. Hutta, W. P. Shulhof, and C. M. Smith. AN INVESTIGATION OF THE AMOUNT AND DISTRIBUTION OF URANIUM IN BASE METAL SULFIDE MINERALS IN VEIN ORE DEPOSITS: U. S. Atomic Energy Comm., [Pub.] RME-3154, 24 p., table, Nov. 1957, pub. Dec. 1958, 3 refs.

Field work during Aug. 1956 was devoted to detailed sampling in the Sunshine mine, Coeur d'Alene district, Idaho, and a number of deposits in the Walapai and Maynard mining districts near Kingman, Arizona, in order to study the relationship of U content of sulfide minerals to that of associated ore. Thick-source alpha-count determinations of equivalent U were made on 184 concentrated, acid-cleaned samples of galena, sphalerite, pyrite, and chalcopyrite. Beta-gamma determinations of equivalent U were made on the bulk ore associated with the sulfides.

Several means have been used to establish a "standard" distribution of alpha tracks in non-contaminated samples for comparison with the distribution obtained from individual samples in order to detect "contamination" U.

Paragenetic studies have been completed on the more important mines and districts sampled, and the sequence of deposition interpreted is described for the Detroit and Golconda mines, Walapai district, Arizona; the Carroll mine, Central City district, Colorado; and the Sunshine mine, Coeur d'Alene district, Idaho.

Experimental studies of trace elements associated with U in sulfides from several localities has been made. The preliminary results showed some variation in Co, Ni, Ag, Bi, Sb, Mn, and As. Analytical procedures of the adequate sensitivity and precision are being developed for determination of these elements at very low levels in small sulfide samples. --From auth. abs.

1-706. Baranov, V. I., and L. A. Kuzmina. THE RATE OF SILT DEPOSITION IN THE INDIAN OCEAN: Geochemistry [Geokhimiya], 1958, no. 2, p. 131-40, 3 graphs, 7 tables, 8 refs.

The ionium, Th, and U contents of 5 selected cores from the Indian Ocean have been determined. Parallel Fe and Mn determinations for the same horizons permit fixing a definite dependence of U and Th contents on Fe and Mn concentrations. The Th content ranges in the upper horizons from about 0.4 to 3.0 micrograms per gram, which agrees with the increased Ca content (up to 40 to 48%); in the intermediate layers the Th-concentration reaches 7 to 10 micrograms per gram. The U concentrations are 0.1 to 0.3 micrograms per gram; the ionium concentration 1.8×10^{-10} grams per gram of silt, which is 30 times its equilibrium values with U; the deposition rates, calculated according to ionium, give values of the order of 1600 to 2000 years. --Auth.

1-707. Clayton, R. N. STABLE ISOTOPES IN NATURE: Mineral Industries, v. 27, no. 7, p. 1-5, 3 illus., Apr. 1958, 9 refs.

Natural variations of abundances of stable isotopes have been used to investigate a wide variety of earth science problems. A brief review of some of these is given. The O^{18}/O^{16} ratios in calcium carbonate of shells provides a method of determination of temperatures in the ancient oceans. Relative temperatures in hydrothermal recrystallization can be obtained from similar measurements around an ore body. Determination of H and O isotopes in snows and glaciers permits dating of ice as a result of annual variations. Sulfur isotope ratios have been used to elucidate the method of formation of the Gulf Coast sulfur deposits. --Auth.

1-708. Vaasjoki, O., and Olavi Kouvo. A COMPARISON BETWEEN THE COMMON LEAD ISOTOPIC COMPOSITION AND MINOR BASE METAL CONTENTS OF SOME FINNISH GALENAS: Econ. Geology, v. 54, no. 2, p. 301-307, map, 3 tables, March/Apr. 1959, 11 refs.

In this article the authors present the results obtained by a geochemical investigation of some Finnish galenas. The spectrographic and mass-spectrographic data show that 2 groups of galenas may be distinguished on the basis of minor base-metal contents and Pb-isotope compositions. The significance of the differences observed is discussed, and the bearing on the source material and deposition of the ore occurrences is given. --Auth.

1-709. Starik, I. E., and L. A. Litvina. APPLICATION OF THE LEACHING METHOD IN EVALUATING THE SUITABILITY OF SAMPLES FOR AGE DETERMINATIONS BY THE ARGON METHOD: Geochemistry [Geokhimiya], 1958, no. 2, p. 213-17, 2 tables, 3 refs.

The K and Ar leaching from K-containing minerals by solutions of Na and various acids has been studied. A considerable dissolution of biotite, heated with strong hot HCl, has been established. The solubility of each biotite sample depends apparently on the state of its preservation. According to the obtained data, an interdependence of the solubility of the biotite and the absolute geological age of the sample has been outlined. Such an interdependence may help to find a criterion for the suitableness of samples for age determination with the Ar method. --Auth.

1-710. Zhirov, K. K., N. V. Baranovskaya, and L. A. Litvina. DETERMINATION OF THE ABSOLUTE GEOLOGIC AGE OF MONAZITES BY THE HELIUM METHOD: Geochemistry [Geokhimiya], 1958, no. 2, p. 218-23, table, 15 refs.

Eight samples of carefully selected altered and unaltered monazites have been studied in order to ascertain the possibilities of age determination with the He method. It has been established that in very carefully selecting the mineral no considerable improvement of the age figures is reached. According to monazites from pegmatites of Karelia [64°N. 32°E.], the age is too low by 300-500 · 10^6 years. The external macro- and microcharacter of the mineral are no reliable criteria in judging the suitableness of the mineral for determinations. The loss of the chief He amount probably occurs during the alteration of the mineral under the action of superimposed hydrothermal solutions and not as a consequence of the process of gradual diffusion resulting from the destructive action of radioactive radiations. --Auth.

8. MINERALOGY AND CRYSTALLOGRAPHY

See also: Geophysics 1-674; Geochemistry 1-699, 1-701; Mineral Deposits 1-747, 1-751, 1-752, 1-755.

1-711. Frondel, Clifford. SYSTEMATIC MINERALOGY OF URANIUM AND THORIUM: U. S. Geol. Survey, Bull. 1064, 400 p., 25 illus., 8 tables, 1958, pub. Jan. 1959, approx. 800 refs.

U and Th minerals, together with a few rare-earth minerals containing U and Th as nonessential constituents, are systematically and comprehensively described in this volume. The classification of the minerals included here is chemical. It is based on the nature of the anion, giving rise to the following broad categories: oxides, carbonates, sulfates, molybdates, phosphates and arsenates, vanadates, silicates, and the niobate-tantalate-titanates or, more properly, multiple oxides. The phosphates and arsenates are described together because in general they are isostructural and form partial or complete solid-solution series. Within each category, minerals of analogous chemical composition and crystal structure are grouped together, such as the torbernite group of minerals within the phosphates in general. No formal distinction is made in the classification between anhydrous species and those containing water or hydroxyl. Almost all of the minerals described are hydrated.

Each mineral species is described according to its synonymy, composition, crystallography and crystal habit, physical properties, optical properties, synthesis, identification, natural formation, and occurrence. The descriptive mineralogy is followed by determinative tables in which the mineral species are arranged according to their x-ray powder-diffraction interplanar spacings, chemical composition, optical properties, color, specific gravity, and fluorescence.

The work is documented by more than 800 references to the world literature of the past 200 years. --Auth.

1-712. Godovikov, A. A., and V. A. Kudryakova. A NEKOTORYKH OSOBENNOSTYAKH PROTSESSA OKISLENIYA SHMALTIN-KHLOANTITA [THE SPECIFIC NATURE OF THE OXIDATION PROCESS OF SMALTITE-CHLOANTHITE]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 37-44, 5 illus., 3 tables, 15 refs.

One of the characteristic peculiarities of the smaltite-chloanthite mineral is its zonal structure. These zones differ from each other in chemical composition and in their content of Co and Ni. Only cobaltic arsenide (skutterudite) is a constant component of all zones. This opinion was long ago expressed by foreign scientists and is now confirmed by chemical tests and by x-ray examinations of thin sections of smaltite-chloanthite taken from the same deposit. The authors describe the procedure adapted for the chemical analyses. The following names are mentioned for work in this field: G. G. Lemmleyn, E. A. Ostroumov, and the chemist A. I. Pokrovskaya from the IGEM Academy of Science of the U.S.S.R. --LC.

1-713. Sokolov, G. A., and P. V. Komarov. IZMENENIYE LUDVIGITA NA MAGNETITOVOM MESTOROZHDENII ZHELEZNYY KRYASH V VOSTOCHNOM ZABAYKALYE [ALTERATION OF LUDWIGITE IN THE MAGNETITE DEPOSIT ZHELESNYY KRYASH IN THE EASTERN TRANSBAIKAL REGION]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 27-37, 7 illus., 3 tables.

The authors describe ludwigite, associated with Mg skarns, as a late skarn mineral deposited metasomatically. It is often found in the contact-metasomatic Zheleznyy Kryash Fe ore deposits. Zones of forsterite skarns, usually serpentinous and containing small quantities of Mg minerals, are common sites for ludwigite. The magnetite is often found in such skarns and even forms magnetite ores. In places where ludwigite occurs, the magnetite usually fills the gaps between the prismatic needles of ludwigite; sometimes magnetite aggregates replace these needles. This circumstance indicates that the magnetite was formed after the ludwigite. Locally, iron sulfides, mainly pyrrhotite, are also developed and belong to a later hydrothermic stage. The rocks containing ludwigite are represented by mineral associations with widely variable amounts of anhydrous skarn minerals, ludwigite, magnetite, sulfides, and other secondary minerals. Sulfides are distributed in these rocks irregularly. In zones with a high sulfide content, the ludwigite occurs in many phases. Samples taken from various depths showed that they contain either thinly dispersed pyrrhotite or colloidal iron sulfides. As a result of various laboratory studies, it was found that the higher the degree of transformation of the ludwigite, the more B it freed, even to such an extent that the Zheleznyy Kryash deposit cannot be commercially exploited. It was also found that the decomposition of the ludwigite is especially intensive in those parts of the deposit where the sulfide mineralization is most pronounced. --LC.

1-714. Vasilyeva, Z. V., and V. I. Kudryashova. APATIT IZ SIBIRSKOY TRAPPOVOY FORMATSII [APATITE FROM A SIBERIAN BASALT FORMATION]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 92-97, 5 illus., table, 5 refs.

Apatite is a constant accessory mineral in "trappean" [basaltic] rock formations. According to A. P. Lebedev, the diabase-pegmatites contain 1% apatite, and, according to V. V. Lyakhovich, the gabbro-diabases, of the Vilyuy region contain 2.86% apatite. It is also found in various micropegmatitic mesostasis of pegmatoid formations in different "traps" [basalt-dolerites] of India, South Africa, and Tasmania. Apatite of post-magmatic origin was never found until recently. One of the authors discovered the crystals of apatite in a hydrothermal vein in the region of the Nizhnyaya Tunguska river [65°48'N. 88°04'E.]. Other apatite crystals were also found in this region. Their characteristics are described in detail. In other regions of Siberia also, A. P. Lebedev and N. V. Pavlov discovered apatite crystals. Chemical analysis showed that the content of rare earths in apatites from the hydrothermal vein was from 2.13 to 0.90%. No rare earths were found in other apatites located in metasomatically altered lava sheets or in the magnetite deposits. --LC.

1-715. White, W. Arthur, and Ernesto Pichler. WATER-SORPTION CHARACTERISTICS OF CLAY MINERALS: Illinois, State Geol. Survey, Circ. 266, 20 p., 22 figs., 1959, 15 refs.

This investigation was made in order to determine the water-sorption characteristics of clay and other mica minerals and to study the relation between such water sorption and the properties of soils and sediments that contain the clay minerals.

Samples of kaolinite, montmorillonite, mica, chlorite group, and sepiolite-attapulgite-palygorskite group were tested in a modified Enslin apparatus, and water sorption was read at increasing time intervals. Sorption curves were plotted as semilogarithmic graphs.

The data show that montmorillonite adsorbs more water than kaolinite, illite, and chlorite. The chlorites and illites have similar water-sorption properties. Mixtures of clay minerals and mixtures of clay minerals and sand tend to have water-sorption properties proportional to the percentage of clay mineral present. --Auth.

9. IGNEOUS AND METAMORPHIC PETROLOGY

See also: Areal and Regional Geology 1-630; Geochemistry 1-700; Mineralogy 1-714; Mineral Deposits 1-747, 1-760; Miscellaneous 1-794.

1-716. Corwin, Gilbert, and Helen L. Foster. THE 1957 EXPLOSIVE ERUPTION ON IWO JIMA, VOLCANO ISLANDS: Am. Jour. Sci., v. 257, no. 3, p. 161-71, 5 illus., 2 maps, March 1957, 7 refs.

An explosive eruption occurred without warning on March 28, 1957, near the center of Iwo Jima, a small volcanic island midway between Guam and Tokyo, Japan. The eruption of steam, volcanic sand, and volcanic sandstone and conglomerate blocks began suddenly at 11:55 A.M. local time, continued for 65 min., and ended abruptly. Coarse ejecta were thrown as high as 150 ft.; dust and steam rose to heights of 200 to 300 ft. No juvenile material was ejected. An elliptical crater 90 to 110 ft. in diameter and 45 ft. deep resulted. Deposits were concentrated to the western (lee) side where they ranged in thickness from 22 ft. near the crater to less than one inch 300 ft. to the W. About 50 min. after the eruption a second crater formed by collapse 75 ft. NW. of the eruption crater. The circular collapse crater was 115 ft. in diameter and 55 ft. deep. Many ground cracks and small faults with displacements up to 8 in. were formed nearby during and following the eruption. Steam and other gases issued from the craters, faults, and cracks following the eruption, and some sublimates were deposited. No significant change of fumarolic activity was noted on other parts of the island before, during, or after the eruption.

The eruption resulted from the sudden release of an underground accumulation of steam under high pressure beneath artificial fill adjacent to an abandoned airfield. The eruption does not seem to indicate an increase in volcanic activity on Iwo Jima. --Auth.

1-717. Bezsmertnaya, M. S., and D. I. Gorshevskiy. OKOLORUDNYYE IZMENENIYA POLIMETALLICHESKIKH MESTOROZHDENIY RUDNOGO ALTAYA [ALTERATION OF THE ORE-BEARING ROCKS OF THE POLYMETALLIC DEPOSITS OF THE RUDNYY ALTAI]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 21-36, diag., 2 graphs, 2 tables, 10 refs.

This article sums up studies by the authors and other geologists of altered rock formations which enclose various polymetallic deposits of the Rudnyy Altai. As a result of the hydrothermal alteration of these rocks, the newly formed minerals are very complex. Their formation depended on conditions which were different for each deposit. In some deposits, the metasomatic process began with the formation of mineral associations at high temperatures (skarns), gradually replaced by formations at average temperatures (epidote-actinolite association), but deposits formed at low temperatures (chlorites, sericites, etc) were most widely distributed. The composition of the mineral metasomatic formations depended on the composition of the initial rocks and hydrothermal solutions. The composition of initial rocks was especially important for the new formations in the lateral parts of the metasomatic zone. There, the chloritization process developed in rocks of basic and neutral composition, the process of sericitization developing in rocks of acid composition. The composition of new mineral formations in the central parts of metasomatic zones was determined mainly by the composition of the hydrothermal solutions. This explains the occurrence of chlorites and sericites in different volcanic or sedimentary rocks. Two types of metasomatic processes could be distinguished. In the first type there is no essential admixture of components, except the hydroxyl. The origin of metasomatic rocks of this type was governed by the degree of intensity of the lixiviation process. The second type was characterized by the intensive admixture of components by hydrothermal solutions. During 2 first stages of the metasomatic process, an intensive addition of Mg and Fe occurred, while in the last stage they were replaced by an admixture of K. The names of the following geologists were cited by the authors for their work in this field: A. K. Kayupov, M. G. Khisamutdinov, N. N. Kurek, G. N. Shcherba, P. N. Kobzar, L. K. Pozharitskaya,

P. F. Ivankin, T. Ya. Goncharova, M. A. Petrova, M. V. Tashchinina, M. S. Korzhinskiy, F. N. Shakhov, V. I. Kazennova, V. P. Bondarev, Z. V. Sidorenko, D. M. Shilin, T. V. Kirova, L. N. Belkova, V. P. Prosnyakov, A. G. Posysoyev, N. A. Ivanova. --LC.

1-718. Tikhomirov, V. V. K VOPROSU O RAZVITII ZEMNOY KORY I PRIRODE GRANITA [THE QUESTION OF THE DEVELOPMENT OF THE EARTH'S CRUST AND THE NATURE OF GRANITE]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 3-15, 31 refs.

Granites and granodiorites, considered by their petrographic characteristics as intrusives of acid composition, are widespread among the massive crystalline rocks of the earth. In the group of extrusive rocks, volcanic products of acid magmas also occupy an important place. Moreover, numerous rock formations, with an almost identical composition as granites, occur as metamorphic rocks. This proves that rocks with a large content of silicic acid play an important role in the formation of the earth's crust. The author summarizes research and scientific work that has been done and finds that, in general, it can be divided into 2 schools of thought: one considers granite to be of a magmatic origin, and the other, of a metamorphic origin. ... Supporters of the magmatic origin of granites disagree as to the origin of acid magma. They think that: 1) acid magma is one of the products of crystallization from a common magma; 2) the interior of the earth contains 3 different magmas, peridotitic, basaltic, and granitic; 3) the earth contains 2 primary magmas, basic and acid; 4) the granitic magma was formed by remelting of sedimentary rocks. The first 3 hypotheses consider granitic magma to be a product of primary origin; and the fourth, that it is a result of remelted rocks and of a secondary (palingenetic) origin.

The author finds that most Precambrian granites are of a secondary metamorphic origin and were formed as a result of either metasomatism or magmatic replacement. The "younger" granites could be considered a result of remelted ancient granites and sedimentary rocks. He substantiates his finding with the following facts: meteorites falling on the earth are always of the same composition and are usually composed of ultrabasic rocks. No acid component was ever found in them. Therefore the author considers that the formation of granites on the earth was caused by different conditions found nowhere else. The whole earth is formed by successive shells differentiated by their geophysical characteristics, and the external sialic shell of the earth was the initial material from which granites were formed. The author stresses the fact that granites are usually found in areas of higher elevation and that it can be said that only elevated areas have favorable conditions for the forming of granite. At the beginning of the article, a note from the editorial board states that they cannot accept the point of view of the author, whose findings are unconvincing. The whole question needs much more research. --LC.

1-719. Kurshakova, L. D. METAMORFICHESKIYE PREOBRAZOVANIYA RUDOVMESHCHAYUSHCHIKH SPILITOV BURIBAYEVSKOGO MEDNOKOLCHEDANNOGO MESTOROZHDENIYA NA YUZHNOM URALE [METAMORPHIC ALTERATION OF ORE CONTAINING SPILITES IN THE BURIBAY CHALCOPYRITE DEPOSIT OF THE SOUTHERN URALS]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 57-64, 3 illus., diag., 2 graphs, 2 tables, 5 refs.

Buribay [51°57'N. 58°10'E.] chalcopyrite deposits occur in rocks of keratophyre-spilite type, which have undergone metamorphic alteration. The author compares them with spilites taken from 2 other chalcopyrite deposits of the Urals. The results of her research show that during the gradual transformation of "fresh" spilites into chloritic schists, their chemical composition changes, e.g., the amount of Na and Ca decreases and the amount of Mg and water as well as the total amount of Mg and Fe increases. The amount of the aluminum oxide changes and the amount of silica remains the same. --LC.

1-720. Olshanskiy, Ya. I., and S. A. Brusilovskiy. PROSTYYE LABORATORNYYE OPYTY, DEMONSTRIRUYUSHCHIYE YAVLENIYE INFILTRATSIONNOY METASOMATICHESKOY ZONALNOSTI [SIMPLE LABORATORY EXPERIMENTS DEMONSTRATING THE PHENOMENON OF INFILTRATION METASOMATIC ZONALITY]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 102-103, diag., ref.

The theory of infiltration metasomatism developed by D. S. Korzhinskiy is still questioned by some geologists. Korzhinskiy proved in his work that, during the infiltration of rocks by natural solutions in some cases, zones, strictly delimited from each other and of different mineral composition, are created. To test this theory, the authors devised an apparatus. It consists of a long glass tube, 15-25 mm. in diameter, connected by a rubber tube with another thinner siphon-type glass tube with a bent end. The larger tube, filled with crushed "mineral," is connected by tape to the lower part of a bottle. From this bottle, the solution passes through the larger tube and flows out through the bent end. The speed of infiltration of the solution through the "mineral" can be regulated by changing the position of the thin glass tube. The experiment was made with pure water infiltrating a mixture of 80% crushed quartz and 20% potassium biochromate ($K_2Cr_2O_7$). After 2-3 hours, 2 zones were formed in the large tube: one (on top) was white and was composed of quartz only, and the second (of orange color) was composed of 2 "minerals" (quartz and hard $K_2Cr_2O_7$). The zones were sharply delineated. By changing the composition of the solution in the bottle, 3 zones are obtained. --LC.

1-721. Marakushev, A. A. PARAGENESES OF LIME SKARNS IN THE TAEZHNOE MAGNESIAN SKARN IRON ORE DEPOSIT IN THE ARCHEAN OF THE ALDAN PLITA: Geochemistry [Geokhimiya], 1958, no. 2, p. 203-12, 4 illus., 4 diags., 2 tables, 3 refs.

The high-temperature, postmagmatic replacement of dolomites has led to the development of 2 metasomatic facies: the Mg and lime infiltration skarns. The dolomite beds and the aluminum-silicate rocks which are directly adjacent to them are replaced by Mg skarns. The somewhat remote aluminum-silicate rocks are replaced by lime skarns.

The lime skarns show that their great variety is caused by the inconstant alkalinity and the oxidation-reduction conditions. The chemical activity of Fe in solution was high but showed greater constancy. The dependence of the parageneses on the chemical potentials of K and O in solution is plotted after D. S. Korzhinsky's method, the constancy of T, P, and of chemical potentials of other quite mobile components (FeO, Na_2O, MgO, et al.) being admitted. Examples of skarnization of aluminum-silicate rocks under various conditions of alkalinity and oxidizing-reducing conditions are considered. --Auth.

1-722. Belov, I. V. O FATSIALNOM RASCHLENENII I KHIMICHESKOM SOSTAVE POROD TRAKHIBAZALTOVOY FORMATSII SAYANO-BAYKALSKOY GORNOY OBLASTI [ON THE FACIES AND THE CHEMICAL COMPOSITION OF ROCKS IN THE TRACHYBASALTIC FORMATION OF THE SAYAN-BAIKAL MOUNTAINOUS DISTRICT]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 76-91, 2 diags., 6 tables, 25 refs.

Intermontane Cenozoic areas of the Sayan-Baikal district [52°45'-54°N. 96°-108°E.] are situated in its northern and northwestern part. The original tectonic development of the region at the end of the Mesozoic and during the Cenozoic periods caused the accumulation of continental sedimentary and sedimentary-volcanic complexes in the depressions and the accumulation of thick extrusive basalts in the anticlines, from which the sedimentary rocks of this period were absent. The author distinguishes among these rocks 3 facies: pyroclastic, blanket, and subvolcanic. Lately, this region has been the object of detailed studies by the following geologists: N. A. Florenskiy, M. L. Lurye, C. V. Obruchev, V. N. Lodochnikov, E. Ye. Fedorov, I. P. Rachkovskiy, Z. A. Lebedeva, P. A. Kropotkin, N. V. Loskutova, A. N. Zavarnitskiy, Ye. P. Moldavantsev, Ye. A. Nechayeva, V. K. Kotulskiy, S. D. Sher, L. I. Salop, A. A. Konev, V. A. Lisiy, I. V. Belov, A. A. Arsenyev, and others. The rocks of the pyroclastic and blanket facies are distinctly divided into 2 age groups, Tertiary and Quaternary. The age of the trachybasaltic rocks of the volcanic facies have been defined as post-Lower Cretaceous. They were not found in the group of the Tertiary age. Pyroclastic rocks were found in many parts of the region. During a detailed study of the region, numerous formations of basaltic tuffs and pyroclastics were found. These rocks preceded the outflow of Tertiary basalts. In the Tunkinskaya Vpadina (depression; 51°30'N. 103°30'E.) deep drilling showed that there were 2 phases of the Cenozoic volcanic activity, one at the end of the Tertiary, and the other during the Quaternary period. The beginning of both phases was accompanied by violent explosive activity and the formation of the pyroclastic beds. The author gives a detailed description of various formations of this type found in different parts of the region. The blanket (pokrovnaya) facies of rocks formed by the basaltic magma can be divided in 2 age groups, Tertiary, called plateau-basalts, and Quaternary, formed by basaltoid lava. When found in depressions and river valleys, they are called valley-basalts. The Tertiary basalts are chiefly composed of olivine, plagioclase, pyroxene, ore minerals, zeolites, and peculiar aluminum silicates of the palagonite type. The Quaternary trachybasaltic rocks are composed of olivine trachybasalts, analcime basalts, various lavas related to shikhlunites, pyroxene, and plagioclastic basalts. The volcanic rocks are of exceedingly variegated composition: black magmatic basaltoid rocks, glomeroporphyric accumulation of olivine, monoclinal pyroxene, teschenites, essexite diabases, proterobases and camptonites, laccolites, and many other varieties of volcanic rocks. Their age has not been defined exactly. The chemical composition of the Cenozoic magmatic rocks of the Sayan-Baikal district can be divided in 3 series: 1) a series of trachybasalts - sodium shikhlunites (this series is represented by alkaline rocks composed of olivine, basic plagioclase, titanium-augite, potash feldspar); 2) a series of essexite-crinanite-limburgites (variegated rocks of this series belong to the subalkaline and alkaline varieties); 3) a series of olivine basalts (plateau-basalts) is a typical representative of calcareous-alkaline lava varieties of the region (olivine, plagioclase, palagonite, carbonatite, and zeolite basalts). Thus, the average composition of basic lavas of the Sayan-Baikal district testifies that, on the whole, all rock formations are of trachybasaltic type, and that this association of Cenozoic rocks cannot be compared with other basalt formations of the world. The earliest Tertiary lavas of the region are calcareous-alkaline types and slightly differentiated, and the Quaternary lavas and the rocks of the subvolcanic facies are of alkaline and sodium type. --LC.

10. SEDIMENTARY PETROLOGY

See also: Geochemistry 1-706; Mineral Deposits 1-754.

1-723. Kuenen, Ph. H. EXPERIMENTAL ABRASION. 3. FLUVIATILE ACTION ON SAND: Am. Jour. Sci., v. 257, no. 3, p. 172-90, illus., 10 figs. incl. diags., graphs, 6 tables, March 1959, 11 refs.

Former experiments by the author dealt with pebble sizes down to 1 cm. The present investigation extends to sizes of 0.4 mm. The mechanism was again that of a current in a circular channel of concrete, but additional tests were made in revolving cylinders. Limestone, feldspar, and mainly quartz were used.

In these sizes mechanical abrasion is found to be entirely negligible in river transport. The elimination of limestone and feldspar during fluviatile transport is therefore not a result of mechanical action. Down-current variation in roundness must be attributed to shape-sorting and/or chemical attack, or to addition from new sources. --Auth.

1-724. Weller, J. Marvin. COMPACTION OF SEDIMENTS: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 273-310, 16 graphs, table, Feb. 1959, 139 refs.

An attempt is made to explore the theoretical relations between compaction of sediments and depth of burial. On the basis of available data and assumptions that seem to be reasonable, a porosity-depth curve for mud and shale is constructed, and overburden pressure is calculated. From these data, other relations of interest in stratigraphy are derived.

Mud and shale are compacted in several stages that involve: (1) squeezing out of interstitial water until the sedimentary grains come in contact with each other; (2) rearrangement of grains and development of closer packing; (3) soft clay minerals are forced into the interstices between the more resistant minerals; (4) the latter are deformed until all porosity is eliminated. The colloidal properties of clay are very important in this process whose results appear to be predictable for sediments with different proportions of clay minerals.

Much less compaction is possible in sand and sandstone because initial porosity is much lower, Colloidal effects are negligible. Most compaction appears to result from intergranular solution, but the results are unpredictable because intergranular cement strengthens structure. No consistent relations exist between porosity and depth of burial.

The consolidation of limestone is not understood. The initial porosity of most calcareous sediments is greater than that of sand but most limestones show little evidence of compaction. Their consolidation appears to have been accomplished by the deposition of intergranular cement at an early stage before the sediment was subjected to the pressure of much overburden. The source of the cementing calcium carbonate is not known.

Organic material, of which coal is presented as an example, is reduced in volume by (1) compression and elimination of pore space, and (2) the loss of substance resulting from, first, biochemical decay and, later, dynamochemical metamorphism. Coal is essentially non-porous and its volume is reduced also by dehydration and increase in specific density. The degradation of organic matter follows one or the other of 2 paths: (1) carbonaceous (coal), leading to development of larger and more complex molecules (polymerization), or (2) bituminous (oil and natural gas), leading to the development of smaller and simpler molecules (cracking). The difference probably is related to the type of decay that occurs very soon after organic material is deposited as a sediment.

Compaction data probably can be applied to the solution of some stratigraphic and structural problems but serious difficulties will remain until the lithification of limestone is more adequately understood. The study of diagenesis has been greatly neglected, and it deserves much increased attention from geologists. --Auth.

1-725. Goldich, Samuel S., C. Oliver Ingamells, and Doris Thaemlitz. THE CHEMICAL COMPOSITION OF MINNESOTA LAKE MARL - COMPARISON OF RAPID AND CONVENTIONAL CHEMICAL METHODS: Econ. Geology, v. 54, no. 2, p. 285-300, fig., 7 tables, March/Apr. 1959, 10 refs.

Chemical analyses of 9 samples of marl from lakes in Minnesota by conventional analytical procedures and by modified or rapid methods that make use of ethylenediamine tetraacetic acid, EDTA, are compared. The 2 procedures report the composition in somewhat different terms. In the rapid analysis, the sodium carbonate fusion for decomposition of the sample is eliminated. Insoluble material rather than SiO_2 is reported; Al_2O_3 is replaced by a difference value, M_2O_3. Results for CaO, MgO, and CO_2 are comparable to the conventional gravimetric determinations.

The Minnesota lake marl is composed chiefly of calcium carbonate with admixed silt, sand, and organic matter. The organic matter complicates the analytical procedures and is removed by ignition of the sample. Ferrous iron and total water cannot be determined. The analyzed samples range from 0.5 to 17% SiO_2 and from 31 to 51% CaO. The MgO content is small, ranging from 1.1 to 1.8%.

The rapid analysis, although designed for Minnesota lake marl, can be applied to other carbonate materials. It has the advantage of permitting a large number of samples to be handled. --Auth.

1-726. Moore, David G., and George Shumway. SEDIMENT THICKNESS AND PHYSICAL PROPERTIES: PIGEON POINT SHELF, CALIFORNIA: Jour. Geophys. Research, v. 64, no. 3, p. 367-74, 5 figs., incl. 3 maps, sec., March 1959, 15 refs.

A 200 sq. mi. area of the continental shelf off Pigeon Point, California (about 40 mi. S. of San Francisco), was studied in regard to the thickness and physical properties of unconsolidated sediments. Sediment thicknesses and water depths were determined by a high-power low-frequency echo sounder which acoustically penetrates unconsolidated sediments to record bedrock and other sub-bottom reflectors. Seventeen sediment sampling stations were made in the survey area. Determinations were made of wet density, porosity, compressional sound speed and absorption (at 20 to 30 kc./s.), static shear strength, sensitivity, and grain size distribution.

The Pigeon Point shelf is a gently sloping, featureless plain whose surface sediments are mainly unlithified sands and silts. Over much of the area these sediments are several tens of meters thick, but between the 40 and 50 fathom contours the sediments thin, and in the southern part of the area bedrock is locally exposed on the sea floor. Bedrock surfaces beneath the sediment blanket form 2 prominent terraces believed to have been cut by wave action during lowered Pleistocene sea levels. --Auth.

1-727. Wagner, W. R. ALBERT NO. 1 WELL, ADAMS TOWNSHIP, SNYDER COUNTY: Pennsylvania Geol. Survey, 4th ser., Well-Sample Rec. no. 41, 23 p., 1958.

The description of samples is very detailed. The detailed sample log has been divided into stratigraphic units. The units have been sub-divided into dominant lithologies, and thicknesses have been assigned to the units.

The text consists of descriptions of each sample taken by the drillers. The samples were washed, placed on a watch glass, covered with water, and examined under a 10-X binocular microscope. Artificial light was filtered through a blue lens and focused on the sample so as to approximate sunlight. In order to be more objective in color description the color chart prepared by the Rock-Color Chart Comm. (distributed by the Geological Society of America) was used. --Auth.

11. GEOHYDROLOGY

See also: Geologic Maps 1-551; Geomorphology 1-637; Geophysics 1-678; Mineral Deposits 1-743; Miscellaneous 1-784, 1-799.

1-728. Leopold, L. B. WATER AND THE CONSERVATION MOVEMENT: U. S. Geol. Survey, Circ. 402, 12 p., 1958.

This paper consists of 2 addresses. The first was presented at Chautauqua, N. Y., July 9, 1957, as a part of a series "New Perspectives on Conservation." The second, "The Nature of our Water Problems," was presented before the American Association of Newspaper Editors, San Francisco, Calif., July 12, 1957.--U. S. Geol. Survey.

1-729. Dodge, James C. I. A GENERAL THEORY OF THE UNIT HYDROGRAPH: Jour. Geophys. Research, v. 64, no. 2, p. 241-56, 11 figs. incl. hydrographs, 3 tables, Feb. 1959, 12 refs.

By the single assumption that the reservoir action in a catchment can be separated from translation, the general equation of the unit hydrograph is shown to be

$$u(O, t) = \frac{V_O}{A} \int_o^{A(t)} \frac{\delta(t - \tau)}{\Pi(1 + K_i D)} \cdot i \cdot dA$$

This is simplified by 2 further simple assumptions to give

$$u(O, t) = \frac{V_Q}{T} \int_o^{t \leq T} P(m, n - 1) \cdot \omega(\tau') \cdot dm$$

which can be conveniently calculated.--Auth.

1-730. Rogers, Allen S. PHYSICAL BEHAVIOR AND GEOLOGIC CONTROL OF RADON IN MOUNTAIN STREAMS: U. S. Geol. Survey, Bull. 1052-E, p. 187-211, 13 illus. (1 in pocket), table, 1958, pub. Feb. 1959, 19 refs.

Rn measurements were made in several small turbulent mountain streams in the Wasatch Mountains near Salt Lake City and Ogden, Utah, to determine the relation between the distribution of Rn and its geologic environment.

In this area, the distribution of Rn in streams can be used to locate points where relatively large amounts of Rn-bearing ground water enter a stream, even though other evidence of springs may be lacking. These points of influent ground water are marked by abrupt increases (of as much as 2 orders of magnitude within a distance of 50 ft.) in the Rn content of the stream waters.

This excess Rn is rapidly lost to the atmosphere through stream turbulence. The rate of Rn dissipation with distance of streamflow, is an exponential function, of different slopes, depending on the rate and volume of streamflow, and the gradient and nature of the stream channel.

Higher Rn concentrations generally can be related to specific stratigraphic horizons in the several drainage areas studied. Thus, lithologic units that act as the primary aquifers can be identified. In one area, thrust faults were found to control the influx of ground water into the stream.

Based on Rn concentrations in streams and related spring waters, estimates of major increments of ground water to streamflow can be made, where conventional methods such as stream gaging are not practical.

The Rn in the waters studied was found to be almost completely unsupported by Ra in solution.--Auth.

1-731. Langbein, W. B. WATER YIELD AND RESERVOIR STORAGE IN THE UNITED STATES: U. S. Geol. Survey, Circ. 409, 5 p., 3 figs., 1959.

This report discusses the trend in reservoir construction and gives estimates of the amount of water that is now made available for use by reservoir storage and the amount that can be made available for additional storage. The relation between storage capacity and regulation is described and includes data for 27 representative reservoirs.--U. S. Geol. Survey.

1-732. Peterson, W. C. WATER RESOURCES SUMMARY FOR SOUTHERN CALIFORNIA, 1957: U. S. Geol. Survey, Circ. 404, 19 p., 7 figs., 1958.

Water supply and precipitation are discussed. Data are given for annual surface runoff in 1957 at 15 selected gaging stations with comparison to the average for a 35-year base period, 1920-55, and for a dry period, 1944-57; also, for runoff in 1956 at all stations in the area. The section on ground water describes conditions in individual valleys and contains hydrographs of 6 observation wells.--U. S. Geol. Survey.

1-733. Bjorklund, L. J. GROUND-WATER RESOURCES OF PARTS OF WELD, LOGAN, AND MORGAN COUNTIES, COLO.: U. S. Geol. Survey, Hydrol. Inv. Atlas HA-9, 3 p., 2 tables, 1957, pub. 1958.

Sufficient ground water for domestic use can be obtained throughout the area. A few wells yield enough water for irrigation or municipal use, but more such wells could be drilled in some parts of the area. A map shows location of selected wells. Chemical analyses and well data are presented in 2 tables. The text discusses geologic formations and their water-bearing properties.--U. S. Geol. Survey.

Section on the chemical quality of the ground water, by F. H. Rainwater.

1-734. Pride, R. W. INTERIM REPORT ON SURFACE WATER RESOURCES OF BAKER COUNTY, FLORIDA: Florida Geol. Survey, Inf. Circ. no. 20, 31 p., 7 figs., 2 tables, Feb. 1959.

The principal sources of surface-water supplies in Baker County are the St. Marys River and its tributaries. However, the flow of many of the small tributaries is intermittent, and without storage they are not dependable sources of supply during sustained periods of deficient rainfall.

Of the 6 stream-gaging stations in Baker County for which complete records are available, one has been in operation for 31 years and provides a long-term record upon which to base correlative estimates for extending the short-term records at the other stations. All available streamflow data to 1957 have been summarized in graphic or tabular form.

The hydrologic balance between minimum streamflows and increased evaporation losses afforded by potential shallow reservoirs provides design criteria for determining the maximum surface area of effective reservoir that can be created at a selected site within Baker County. This information has been presented in graphic and tabular form in the report. --Auth.

1-735. Wait, Robert L. SOURCES OF GROUND WATER FOR IRRIGATION IN DOUGHERTY COUNTY, GEORGIA: Georgia Mineral Newsletter, v. 11, no. 4, p. 123-27, 4 figs., 2 tables, Winter 1958, 6 refs.

Most of the farmland in Dougherty County is within a few hundred feet of a good supply of irrigation water in the form of ground water, which is available for either supplemental or full-scale irrigation.

Albany receives an average of 49.5 in. of precipitation per year, but poor distribution prior to planting and during the growing season resulted in poor corn yields in 1957. A thick covering of red to brown sandy clay derived from the weathering of Ocala limestone is present at the surface throughout the county. The Ocala limestone beneath is the principal source of domestic, industrial, and irrigation water. Sinkholes are prominently developed. These contain water during times of excessive rainfall and allow the water to move downward slowly and to recharge the ground-water body in the underlying Ocala limestone. The Tallahatta formation of the Claiborne group (underlying the Ocala) and the deeper Clayton formation are also sources of ground water.

Wells designed to obtain water from the Ocala limestone and the Clayton formation are of simple construction. However, wells that obtain water from the Tallahatta formation or from Upper Cretaceous aquifers utilize well screens.

The cost of pumping water and the feasibility of surface ponds are 2 factors to be considered in the use of water for irrigation. All water samples tested except one had a low sodium hazard and a low to medium salinity hazard, indicating that most ground water would be chemically suitable for irrigation. --G. E. Denegar.

1-736. Owen, Vaux, Jr. SUMMARY OF GROUND-WATER RESOURCES OF LEE COUNTY, GEORGIA: Georgia Mineral Newsletter, v. 11, no. 4, p. 118-21, 2 tables, Winter 1958.

Although geologic conditions vary from one place to another, every part of Lee County, in SW.-central Georgia, is within a short distance from abundant ground-water supply. Ground water is used to meet rural domestic, municipal, agricultural, and industrial needs. It could be developed on a much larger scale to aid the economy of the county.

The same formations are present throughout the county but they dip and become thicker toward the SE. Some water is still available from shallow wells dug in the sandy clay residuum derived from the weathering of the Eocene Ocala limestone, but dug wells are rapidly being replaced by deeper drilled wells. Most of the water supply of Lee County comes from Ocala limestone, which thickness from about 15 ft. in the NW. to about 150 ft. in the SE. In areas where the Ocala cannot be used, domestic supplies are usually obtained from screened wells penetrating sands of the Claiborne group, also Eocene, which ranges from 130 ft. in the NW. to 300 ft. in the SE. The Clayton formation (Paleocene) is considered a good aquifer but is so far little used. Upper Cretaceous sands are important aquifers to the N., and it is probable that large supplies of water could be obtained from these sands anywhere in Lee County.

Artesian springs flow from the Ocala limestone. Some are used for domestic water supplies, some for recreational purposes. Others are not used at all. They constitute a ground-water source of which little use has been made.

Drilled wells in the Ocala limestone are commonly 3 in. in diameter and are about 100 ft. deep. They have an average of 40 ft. of casing. Wells utilizing the Claiborne group range from 50 to 400 ft. in depth and require screens. In general, the chemical quality of water makes it suitable for most purposes, although water from the Ocala limestone is rather hard. Excessive Fe is a problem in water from the Claiborne group in Sumter County to the N., but Fe does not seem to be excessive in the Lee County water from the Claiborne. --G. E. Denegar.

1-737. Newcomb, L. E. LEE COUNTY'S RIVERS AND STREAMS: Georgia Mineral Newsletter, v. 11, no. 4, p. 121-23, graph, Winter 1958.

Lee County, in the upper Coastal Plain region of southwestern Georgia, is an area characterized by low relief, with stream channels and numerous limestone sinks forming depressions in an otherwise smooth plain. The county lies entirely within the basin of the Flint River. The western part of the county is drained by Kinchafoonee Creek, and the central part by Muckalee Creek. The eastern and northern parts are drained by Cherokee Creek and other small tributaries. The streams are generally sluggish, and they flow in deep, meandering, low-banked, tree-choked channels bordered by wide, swampy, densely-wooded valleys. Discharge by streams averages about one-fourth of the rainfall.

Runoff varies from place to place. Differences result, in part, from variations in topography, geology, soil, and vegetation. Distribution of springs is an important factor during periods of low flow.

The main stem of the Flint River is Lee County's principal river resource. Its flow is regulated by the Crisp County power plant and reservoir. The quality of water in the rivers and streams is satisfactory for most purposes. Average hardness of water samples of the Flint River at Bainbridge is 46 ppm. Flint River can provide, in Lee County, enough water to support a larger population. Small streams could provide for an enormous increase in the use of water for irrigation. --G. E. Denegar.

1-738. Groff, S. L., and Albert W. Stone. A SUMMARY REPORT ON THE GROUND-WATER SITUATION IN MONTANA WITH CHAPTER ON MONTANA AND THE LAW OF GROUNDWATER: Montana Bur. Mines & Geology, Inf. Circ. 26, 45 p., 7 illus., 39 refs., Dec. 1958.

Written for the layman, this report briefly explains ground-water science and summarizes the geological and geographical occurrence of ground water in Montana. The State has vast ground-water resources, but accelerating use in the last decade has created the danger of over-use in some areas. Continuous study of these resources is of primary importance and leads to the establishment of adequate controls based on fact. Present ground-water law in Montana is compared with that elsewhere, and some recommendations to improve the law are presented. --Auth.

1-739. Criner, James H., and Clarence A. Armstrong. GROUND-WATER SUPPLY OF THE MEMPHIS AREA: U. S. Geol. Survey, Circ. 408, 20 p., 8 illus., fold. map, 3 tables, Feb. 1959, 14 refs.

The Memphis area of this report comprises about 1000 sq. mi. of the part of the Gulf Coast plain known as the Mississippi embayment. It includes Shelby County, Tenn., and small parts of Arkansas and Mississippi. The area is underlain surficially by clay, silt, sand, and gravel of Recent, Pleistocene, and Pliocene age, and these materials are underlain in turn by sand and interbedded lignite, clay and silt of Eocene age, clay and sand of Paleocene age, and sand, clay, and chalky limestone of Cretaceous age. Only units of Eocene age and younger are discussed in this report.

Most of the water used in the area is derived from the "500-foot" sand of the Claiborne group and the "1400-foot" sand of the Wilcox group, both of Eocene age. In 1955, the average daily pumpage of water from all sources was 137 million gallons, 90% of which was obtained from the "500 foot" sand. Municipal pumpage accounted for 60 million gallons per day, industrial pumpage about 70, and domestic and irrigation pumpage about 7.

The quality of the water from the "500-foot" and "1400-foot" sands is very good.

Records of more than 300 wells in the area, as well as logs and geologic data collected outside the area, were tabulated for study and evaluation. These data have been collected continuously by the U. S. Geological Survey since 1940.--U. S. Geol. Survey.

1-740. Knowles, Doyle B., and Richard A. Kennedy. GROUND-WATER RESOURCES OF THE HUECO BOLSON NORTHEAST OF EL PASO, TEXAS: U. S. Geol. Survey, Water-Supply Paper 1426, 186 p., 14 figs., 11 pls. (in separate cover), 6 tables, Jan. 1959, 24 refs.

The Hueco Bolson is in the extreme western part of Texas and S.-central New Mexico, covering parts of El Paso County, Texas, and Dona Ana and Otero counties, New Mexico. Wells tapping the bolson deposits furnish the major part of the water supply for the city of El Paso, Ciudad Juarez, Fort Bliss, Biggs Air Force Base, and private industries in the area. The progressively increasing demand for water made it obvious that a comprehensive investigation of the quantity and quality of water in storage in the entire Hueco Bolson would be essential for the proper planning of future water supplies. A test-drilling program was started in 1953, jointly sponsored by the city of El Paso, the U. S. Army, the U. S. Air Force, and the Texas Board of Water Engineers. The drilling was supervised by the U. S. Geological Survey.

Thirty-three deep test wells were drilled, comprising a total footage of 32,456 ft. Water samples for chemical analysis were obtained by means of drill-stem tests at most of the wells, an electric log was made after each test well was completed, water-level measurements were made in each well, and pumping tests were made at several selected wells. In addition to the test-drilling program, all available information was collected for existing wells in the area, and chemical analyses were made of water samples collected from many of the wells.

The Hueco Bolson is an intermontane lowland sparsely covered with low vegetation. The bolson is traversed by the Rio Grande valley, the portion of which S. of El Paso, known locally as the Lower Valley, is reached by an abrupt drop of 200 to 300 ft. from the bolson surface, which is known locally as the Mesa. No well-developed drainage channels are on the Mesa, and the precipitation on it either infiltrates or is lost by evapotranspiration. The average annual evaporation from a U. S. Weather Bureau class A evaporation pan, based on a 4-year period, is 108.15 in., whereas the average annual precipitation, based on a 75-year record, is 8.65 in.

The bedrock that underlies the bolson deposits and makes up the surrounding mountains is relatively impermeable and will not supply large quantities of water to wells. The Franklin and Organ mountains, which form part of the western boundary of the Hueco Bolson, consist largely of granitic and porphyritic rocks that were the source beds for much of the bolson deposits. The latter consist of lenticular layers of clay, sand, and gravel, which cannot be correlated for long distances. The sands and gravels are thickest and coarsest near the Franklin and Organ mountains and become progressively thinner and finer grained toward the E. The maximum known thickness of the bolson deposits is 4,920 ft. Caliche lying nearly everywhere beneath the surface of the bolson affords a rather effective barrier to recharge from above. The caliche beds are partly or completely missing beneath depressions in the bolson, however, and recharge takes place when water collects in the depressions during periods of heavy rainfall.

Contours of water levels in the Hueco Bolson show that the principal area of recharge is along the E. edge of the Franklin and Organ mountains, where the runoff from the mountains infiltrates into the coarse gravel of alluvial fans. The water in the bolson deposits in the Mesa is unconfined and almost everywhere is of good quality. The bolson deposits in El Paso valley contain fresh water but are overlain and underlain by alluvial deposits containing mineralized water. The lowering of the artesian head in the bolson deposits in places has permitted the infiltration of salt water into the fresh-water-bearing beds. Two large cones of depression, one in El Paso valley and one in the Mesa, have been formed by large withdrawals of ground water.

Pumpage from deep wells in the El Paso area has increased steadily since 1906. The average withdrawal in 1953 was 27.9 mgd. (million gallons per day), of which 13.2 mgd. was pumped from wells in the Mesa and 14.7 mgd. was pumped from wells in the El Paso valley.

The fresh water - defined as that containing less than 250 ppm. (parts per million) of chloride - in the Hueco Bolson is in a trough of irregular width and depth roughly parallel to the Franklin and Organ mountains. Salt water - defined as that containing more than 750 ppm. of chloride - is present in the bolson sediments that lie beneath and E. of the fresh-water-bearing beds and in the younger alluvium in the El Paso valley. A body of inferior water is present between the fresh and salt water and differs in thickness from place to place.

Pumping tests at wells in the Hueco Bolson showed that the coefficient of transmissibility ranged from 38,000 to 164,000 gpd. (gallons per day) per ft. Because of the shortness of the tests, the coefficient of storage of the bolson deposits could not be determined accurately.

The volume of the saturated bolson deposits in Texas is at least 31.6 million acre-ft. and in New

Mexico at least 24.8 million acre-ft. Of this, about 7.4 million acre-ft. in Texas and 6.2 million acre-ft. in New Mexico is available for recovery by wells. On the basis of about 50% recovery of the available water, 30 mgd. could be withdrawn from storage for a period of 110 years. Artificial recharge would extend this period. Suggested methods of artificial recharge are by means of wells on the Mesa and a system of ditches and detention dams in the arroyos along the mountain fronts.

Although a large quantity of water is available in the bolson deposits, detailed planning and proper development will be necessary to secure maximum recovery from the reservoir without serious salt water encroachment. --Auth.

12. MINERAL DEPOSITS

See also: Geologic Maps 1-550, 1-551, 1-561, 1-562, 1-567, 1-569, 1-623, 1-624, 1-625; Geochemistry 1-691, 1-701, 1-705; Mineralogy 1-712, 1-713; Igneous and Metamorphic Petrology 1-717, 1-719, 1-721; Miscellaneous 1-793.

1-741. Ridge, John D. FEDERAL AID TO THE MINING INDUSTRY - ITS PROBLEMS AND POSSIBILITIES: Mineral Industries, v. 28, no. 3, p. 1-6, Dec. 1958.

The present difficulties of the U. S. mining industry derive largely from the expansion program that started at the end of World War II and reached its peak of production coincidentally with the 1958 recession. Low prices caused by the recession have forced many domestic mining firms to curtail production or go out of business altogether. This, in turn, has reduced the ability of the industry to meet any emergency demands which the cold war might occasion. Suggestions have been made to Congress by the Federal Administration or put into effect without congressional approval in an effort to stabilize prices and increase the domestic share of the total mineral raw-material market, but each has been put forward as a complete answer in itself. Those proposed to Congress were flexible tariff schedules and flexible subsidies, both tied to the current market price. Those adopted without direct congressional approval were stockpiling beyond strategic requirements and import quotas. In setting up the quota system, the Administration has reserved a variable share of the U. S. market to domestic producers. Because the quota system is based on imports in previous years, there is no direct connection between total U. S. demand in a given year and the proportion which import quotas will allow to be met from domestic sources. Import quotas directly related to total U. S. consumption would have provided a more definite and satisfactory base for U. S. operators to plan current and future production. Because of other difficulties inherent in accurate forecasting of domestic mineral demand, it is suggested that stockpiling should be used to supplement the quota system by absorbing excess U. S. production or by providing additional supplies, depending on demand in a given year. It is also thought probable that the quota and stockpiling operations would have to be supplemented by domestic mining quotas and subsidies (for certain mineral commodities at least) if a sound control program is to be put into effect. --Auth.

1-742. Luttrell, Gwendolyn W. ANNOTATED BIBLIOGRAPHY ON THE GEOLOGY OF SELENIUM: U. S. Geol. Survey, Bull. 1019-M, p. 867-972, 2 illus. (1 in pocket), Feb. 1959.

This bibliography includes annotations of nearly 400 papers on the geologic occurrence, mineralogy, and geochemistry of Se, as well as papers on metallurgy, analytical procedures, biologic effects, production, and uses of Se which are of geologic interest. A summary of the uses, mineralogy, geochemistry, and geologic occurrence of Se is contained in the introduction. --Auth.

1-743. Belyakova, E. E. MIGRATION OF ELEMENTS IN UNDERGROUND AND SURFACE WATERS OF THE UPPER-KAIRAKTY DISTRICT, CENTRAL KAZAKHSTAN: Geochemistry [Geokhimiya], 1958, no. 2, p. 176-88, 3 geol. maps, graph, 2 tables, 6 refs.

The regularities of distribution in the migration of metals in underground and surface waters of the Verkhnekairaktinsk district in central Kazakhstan are considered, and the problems of the formation of hydrochemical anomalies and of water dissemination halos of ore elements have been considered. Methods of analyzing the hydrochemical anomalies in prospecting for ore deposits in an arid climate are demonstrated. --Auth.

1-744. Canney, F. C. GEOCHEMICAL STUDY OF SOIL CONTAMINATION IN THE COEUR D'ALENE DISTRICT, SHOSHONE COUNTY, IDAHO: Mining Engineering, v. 11, no. 2, p. 205-210, 3 figs. incl. 2 maps, 2 tables, Feb. 1959, 6 refs.

Contamination is a hazard in most geochemical surveys that can interfere by creating spurious anomalies or by raising the background to such a level that true anomalies are no longer easily detectable. The areal extent of contamination patterns surrounding the Pb and Zn smelters in the Coeur d'Alene district were investigated by determining the Pb and Zn content of profile soil samples collected from 46 sites mostly within a 5-mi. radius of the smelter. Within the area studied, the degree of contamination below a depth of 6 in. is not sufficently great to interfere seriously with the use of geochemical techniques; but to provide a safety factor, a soil-sampling depth of 10 in. is recommended. --Auth.

1-745. Theobald, P. K., Jr., and C. E. Thompson. GEOCHEMICAL PROSPECTING WITH HEAVY-MINERAL CONCENTRATES USED TO LOCATE A TUNGSTEN DEPOSIT: U. S. Geol. Survey, Circ. 411, 13 p., 5 figs., 4 tables, Jan. 1959, 7 refs.

Rapid field chemical analysis of heavy-mineral concentrates panned from stream gravels provides a reconnaissance prospecting technique for many of the ore minerals that are resistant to chemical and mechanical decay. This technique involves 3 steps: areal reconnaissance by sampling the mouths of major streams to locate drainage basins with anomalous metal content; tracing an anomaly through a drainage basin by sampling the main stream and tributaries, proceeding upstream until the anomaly is terminated; and tracing the metal away from the stream to the bedrock source by conventional geologic or geochemical prospecting techniques. On the eastern slope of the central part of the Front Range, Colorado, a previously unsuspected W anomaly was traced through the Clear Creek drainage basin to West Fork Clear Creek and Woods Creek and was isolated in an avalanche slope on the SE. side of Red Mountain. The anomaly was traced by chemical analysis of the fine fraction of debris on the avalanche slope to a huebnerite deposit near the crest of the peak. Despite sampling and analytical problems this technique is valuable for locating mineralized ground because of its speed and low cost. --Auth.

1-746. Pollock, D. W. SULFIDE PARAGENESIS IN THE EASTERN METALS DEPOSIT, MONTMAGNY COUNTY, QUEBEC: Econ. Geology, v. 54, no. 2, p. 234-47, 5 figs. incl. 2 maps, 2 tables, March/ Apr. 1959, 12 refs.

The Eastern Metals deposit, Montmagny County, Quebec, is characterized by 2 sub-parallel zones of mineralization approximately 400 ft. apart on the surface. The Ni minerals millerite, gersdorffite, and violarite have been identified in the North zone, and chalcopyrite is the ore mineral of the South zone. Sphalerite is present in each zone. The ores are localized in zones of silicification and carbonatization along the contact between a serpentinized peridotite and slate fingers penetrating into the SW. end of the peridotite. The mineralization is postulated to have come about by the dissolving of separate pods of copper and nickel sulfides that originated during the crystallization of the peridotite. The agent responsible for the solution and deposition of the sulfides was oxidizing solutions that accompanied the intrusion of granodiorite dikes. The minerals were deposited in the alkaline environment of the silica-carbonate zone. The sphalerite was derived from the surrounding sediments by solution by the same solutions that carried the Cu and Ni. --Auth.

1-747. Schwartz, George M. HYDROTHERMAL ALTERATION: Econ. Geology, v. 54, no. 2, p. 161-83, 2 tables, March/Apr. 1959, 95 refs.

Early in the investigation of epigenetic mineral deposits it was recognized that hot solutions were important and that wall-rocks were commonly highly altered.

Physical changes in the wall-rock are conspicuous, especially bleaching, development of porosity, permeability, and textural changes. The changes, however, are varied and some rocks become dark colored, others dense and impervious.

Changes in mineralogy are complex, but less commonly only recrystallization may occur. The list of minerals and mineral groups formed by hydrothermal alteration comprises 68 names and doubtless will be expanded as research continues. The most characteristic minerals include sericite, quartz, chlorite, sulfides, epidote, zoisite, clinozoisite, leucoxene, clay minerals, calcite, and other carbonates. Minerals formed at an early stage may alter to other minerals as the process continues. Some minerals, such as biotite, may be susceptible to alteration but on occasion form as an alteration product. Quartz is the only abundant primary mineral that commonly resists destruction by hydrothermal processes.

The chemical composition of rocks and of hydrothermal solutions forms chemical systems of extreme complexity. Therefore, the chemical reactions and ultimate chemical changes are varied. Substances such as H_2O, SiO_2, S, Co_2, K, Na, Ca, Mg, B, F, and so on are introduced into the rocks or transferred from one place to another. The composition of the wall-rock exerts a strong influence on the early stage alteration whereas the composition of the solution is dominant in the late stage.

The nature of the process of hydrothermal alteration is such that zones of alteration are a normal result. These are not uniform but naturally depend on the composition of the wall-rock and of the solutions, with changes in the solutions during the process having a strong influence.

As a result of intense alteration, dissimilar rocks, particularly igneous rocks, tend to develop a uniform product consisting in some districts, for example, of quartz and sericite.

A conspicuous feature of the alteration of the wall-rocks of some veins is that there is little relation to the composition of the vein. Thus gold quartz veins in California have a highly carbonatized wall-rock.

The nature of wall-rock alteration has an important bearing on inferences as to the source of the hydrothermal solutions because of the complex chemical additions in some examples. --Auth.

1-748. Rossman, Darwin L. GEOLOGY AND ORE DEPOSITS IN THE REID INLET AREA, GLACIER BAY, ALASKA: U. S. Geol. Survey, Bull. 1058-B, p. 33-59, 7 illus. (2 in pocket) incl. geol. map, scale 1 in. to approx. 1450 ft., March 1959, 4 refs.

A Au-bearing area of about 7 1/2 sq. mi. near the head of Glacier Bay between Reid and Lamplugh glaciers was first discovered by Joseph Ibach in 1924. The dominant rock type in the area is granodiorite, which is intruded into bedded rocks that may be of Paleozoic age. The bedded rocks consist of conglomerate, limestone, and black graphitic schist. A light-colored quartz diorite younger than the granodiorite crops out S. of the mapped area.

Most of the ore deposits are found in fissure-type quartz veins in both the granodiorite and the older bedded rocks. The mineralizing solutions that brought in the Au have altered the country rock for as much as a few tens of feet on each side of the fissures. Locally this altered rock is Au-bearing, but in the places sampled the Au content was found to be too low for mining to be profitable.

Most of the quartz veins are lenticular, both horizontally and vertically, and the Au tends to be concentrated in discrete spots along the veins. These factors cause the ore to be spotty and its location to be unpredictable, and has led to the concept that at many places the ore does not continue below the surface. Geologically, however, there appears to be no reason to believe that Au mineralization is confined to surface outcrop.

The LeRoy and Rainbow properties are the only 2 within the mapped area that have yielded significant quantities of Au, but the veins on the Highland Chief and probably the Rambler claims appear to be of sufficient size and grade to be potential ore producers.

The LeRoy mine is the largest in the area. The ore body consisted of a fissure-type quartz vein with an average width of 2 to 3 ft. and a length of about 60 ft., but in 1954 all the ore in the main vein had been mined out above the main working level. Probably several hundred tons of ore was mined and milled from the Rainbow vein.

The results of an investigation of a mineralized area near Lituya Bay are included in this report. The mineralized material consists of hydrothermally altered rock found in volcanic rocks believed to be of Mesozoic age. The Au content of the observed altered rock is too low for profitable mining, but spots may be discovered in which the Au concentration is sufficiently high to be of economic significance. --Auth.

1-749. Pearre, Nancy, and Allen Heyl. THE HISTORY OF CHROMITE MINING IN PENNSYLVANIA AND MARYLAND: Pennsylvania Geol. Survey, 4th ser., Inf. Circ. 14, 23 p., 9 figs., 1959.

The history of rock chromite mining and placer chromite recovery in Pennsylvania and Maryland is traced from its inception, about 1810, up to the present time. Of the 40 mines and prospects known, some data is available for 27 of the most important. Between 250,000 and 280,000 tons of chromite were mined, in addition to about 15,000 tons of placer chromite. The ore ranged from somewhat less than 30% Cr_2O_3 up to about 55%. Shortly after discovery, much of the Pennsylvania and Maryland chromite was under the control of Isaac Tyson, Jr., and his sons, who continued operations until 1882 when the Wood mine closed, ending the supremacy of chromite production in eastern United States. Placer mining was continued into the early 1900's. During the 2 world wars, interest in the old chromite mines was revived, but no significant production resulted. --Auth.

1-750. Petersen, Richard G., John C. Hamilton, and Alfred T. Myers. AN OCCURRENCE OF RHENIUM ASSOCIATED WITH URANINITE IN COCONINO COUNTY, ARIZONA: Econ. Geology, v. 54, no. 2, p. 254-67, 2 maps, columnar sec., 4 tables, March/Apr. 1959, 11 refs.

Twenty-nine samples of sedimentary rocks of Triassic age from the Sun Valley U mine in northern Arizona were analyzed spectrographically; 11 of these samples contained 0.005 to 0.1% of the rare metallic element, Re.

The Re is associated with U and Mo (and probably with Pb and Zn). It is probably in the form of the water soluble oxide (Re_2O_7) or perrhenic acid ($HReO_4$). The Re may have been contained originally in the mineral jordisite. This is indicated by the association of the rhenium oxide with the water-soluble Mo mineral, ilsemannite.

The Sun Valley mine is the only U deposit on the Colorado Plateau known to contain any Re. --Auth.

1-751. Bates, Thomas F., Erwin O. Strahl, and Robert L. O'Neil. AN INVESTIGATION OF THE MINERALOGY AND PETROGRAPHY OF URANIUM-BEARING SHALES. ANALYSES OF SHALE SAMPLES: U. S. Atomic Energy Comm., [Pub.] NYO-7909, 91 p., fig., Aug. 1958, pub. 1959.

Data contain analyses of 1,135 shale samples taken from 29 drill cores of 9 shale formations. The geographic location and geologic age of each shale formation are described, and the source of each core is given. Analytical methods used include fluorimetric determination of U, x-ray fluorescence measurement of Fe, and chemical determinations of total C, carbonate C, free Fe, and total silicates. Chemical data were recalculated to give the amount of organic C, calcite, siderite, pyrite, and iron oxides. --G. E. Denegar.

1-752. Lovering, T. G., and E. P. Beroni. PRELIMINARY STUDY OF RADIOACTIVE LIMONITE IN COLORADO, UTAH, AND WYOMING: U. S. Geol. Survey, Bull. 1046-N, p. 339-84, 15 illus., 14 tables, Feb. 1959, 12 refs.

Nine radioactive-limonite localities of different types were sampled during the spring and fall of 1953 in an effort to establish criteria for differentiating limonite outcrops associated with U or Th deposits from limonite outcrops not associated with such deposits. The samples were analyzed for U and Th by standard chemical methods, for equivalent U by the radiometric method, and for a number of common metals by semiquantitative geochemical methods. Correlation coefficients were then calculated for each of the metals with respect to equivalent U, and to U, where present, for all the samples from each locality. The correlation coefficients may indicate a significant association between U or Th and certain other metals. Occurrences of specific metals that are interpreted as significant vary considerably for different U localities but are more consistent for the Th localities.

Samples taken from radioactive outcrops in the vicinity of U or Th deposits can be quickly analyzed by geochemical methods for various elements. Correlation coefficients can then be determined for the various elements with respect to U or Th; if any significant correlations are obtained, the elements showing such correlation may be used as indicators of U or Th elsewhere in the area. Soil samples of covered areas in the vicinity of the radioactive outcrop may then be analyzed for the indicator elements and any resulting anomalies used as a guide for prospecting where the depth of overburden is too great to allow the use of radiation-detecting instruments. Changes in color of limonite stains on the outcrop may also be a useful guide to ore in some areas.

Correlation coefficients of the associated indicator elements, used in conjunction with petrographic evidence, may be useful, too, in interpreting the origin and paragenesis of radioactive deposits. --Auth.

1-753. Pierson, C. T., W. F. Weeks, and F. J. Kleinhampl. RECONNAISSANCE FOR RADIOACTIVITY IN THE METAL-MINING DISTRICTS OF THE SAN JUAN MOUNTAINS, COLORADO: U. S. Geol. Survey, Bull. 1046-O, p. 385-413, 5 illus. (2 in pocket), 4 tables, 1958, pub. Jan. 1959, 25 refs.

Thirty-four metal-mining districts in the San Juan Mountains, Colorado, were investigated during 1951-53 in a reconnaissance for radioactive materials. No commercial U deposit was found during the reconnaissance, but one deposit has since been discovered and developed in the Cochetopa area by private interests. Except for the Cochetopa deposit, all the known occurrences of U minerals are small or of low grade. Additional prospecting, however, might result in the discovery of small ore deposits of U, or of ores of other metals that contain sufficient U to be produced as a byproduct.

Samples collected from the Bonanza, Upper Uncompahgre, La Plata, and Red Mountain districts contain 2.71, 0.53, 0.40, and 0.35% U, respectively; samples from the Telluride, Lower Uncompahgre, Rico, Engineer Mountain, Burrows Park (Whitecross), Carton Camp, and Creede districts contain smaller though significant amounts of U. Radioactivity caused by Th is known in the Cebolla-Powderhorn district and in the Burrows Park (Whitecross) district. Rn was largely responsible for the radioactivity measured in the Mount Wilson district.

In the Bonanza district, pitchblende was found on the dump of the caved Whale adit, where it is associated with pyrite, galena, chalcopyrite, tetrahedrite, and enargite as fracture coatings in silicified andesite of Tertiary age. In the Upper Uncompahgre district, pitchblende was found in the Michael Breen mine in a narrow vein in the San Juan tuff of Tertiary age and near Bear Creek Falls S. of Ouray in a shear zone in the slate of the Precambrian Uncompahgre formation. In the La Plata district, small amounts of U are contained in limonite in altered Tertiary diorite from a surface trench on the Tomahawk vein. In the Red Mountain district, pitchblende occurs in the pyritic Ag-bearing galena-sphalerite-chalcopyrite-enargite ores from several chimney and vein deposits of Tertiary age. In the Telluride district a U-bearing hydrocarbon is found in pyritic and silicious galena-sphalerite ore from the footwall of the Montana vein in the San Juan tuff of Tertiary age. The small amounts of U in the other districts occur with base-metal sulfide ores from several geologic environments. --Auth.

1-754. Landis, E. R. RADIOACTIVITY AND URANIUM CONTENT, SHARON SPRINGS MEMBER OF THE PIERRE SHALE, KANSAS AND COLORADO: U. S. Geol. Survey, Bull. 1046-L, p. 299-319, 6 illus. (4 in pocket), 4 tables, March 1959, 16 refs.

As part of the program of the U. S. Geological Survey in the investigation of U-bearing carbonaceous rocks on behalf of the U. S. Atomic Energy Commission, a reconnaissance of the Sharon Springs member of the Pierre shale of Late Cretaceous age in western Kansas and eastern Colorado was made during 1954.

The Sharon Springs member of the Pierre shale and its lateral equivalents range from 155 to about 500 ft. in thickness and generally contain about 0.001% U, but some beds contain larger amounts. A 6-ft. shale bed in Cheyenne County, Colorado, contains about 0.006% U; a 4 1/2 ft., 0.004 and 0.005% U; and a 3 1/2 ft. sequence of beds in Klowa County, Colorado, contains about 0.004% U. At several outcrop localities, sequences of beds as much as 9 1/2 ft. thick contain about 0.003% U. Data from wells indicate that the 4 1/2 ft. thick sequence of beds in Crowley County, Colorado, may have a lateral extent of at least 5 1/2 mi. A gamma-ray log of a well in Yuma County, Colorado, indicates a sequence of beds 66 ft. thick which contains 0.005 to 0.010% equivalent U.

No definite pattern of areal distribution of radioactivity and U content in the Sharon Springs is indicated by available data. Lateral variation in U content of individual beds was not noted in outcrops, which seldom extend more than 150 ft. Subsurface data from gamma-ray logs of wells indicate however that both the maximum radioactivity and the thickness of radioactive beds are variable within distances of a few miles. Most of the gamma-ray logs show that only part of the sequence of rocks comprising the Pierre shale and Niobrara formation exhibits radioactivity in excess of the average radioactivity of the 2 formations. Comparison of gamma-ray logs of wells in northeastern Colorado suggests that the most radioactive parts of the Pierre shale and Niobrara formation are a laterally correlatable sequence of beds.

The stratigraphic position of the radioactive unit relative to the Pierre shale-Niobrara formation contact in oil-industry scout reports, as identified from electric logs of wells, is variable within short distances. This may indicate that some of the Pierre-Niobrara contacts picked from electric logs may not correspond to the boundary that would be selected by examination of the rocks themselves, or it may indicate a facies relationship between the lowermost part of the Pierre shale and the uppermost part of the Niobrara formation. --Auth.

1-755. White, Eugene Wilbert. AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY, AND PALEOBOTANY OF URANIUM-BEARING LIGNITES. URANIUM MINERALIZATION IN SOME NORTH AND SOUTH DAKOTA LIGNITES: U. S. Atomic Energy Comm., [Pub.] NYO-7948, 79 p., 8 figs. incl. graphs, photomicrographs, 8 tables, Apr. 1958, pub. 1959, 34 refs.

The megascopically visible U minerals from 11 deposits of Tertiary lignite from North and South Dakota are characterized on the basis of optical, chemical, x-ray diffraction, and dehydration properties. The U mineral occurrences are divided into 3 areas on the basis of stratigraphy and geography.

Eleven of the 12 minerals are hydrated uranium phosphates; one is an arsenate. Eleven, including the arsenate, belong to the group of torbernite-metatorbernite minerals. Sodium-autunite, $Na_2(UO_2)_2(PO_4) \cdot nH_2O$, is found in 4 of the deposits. This is the first reported occurrence of the mineral in this country. The other identified minerals include: meta-uranocircite, meta-autunite, hydrogen-autunite, saleéite, sabugalite(?), abernathyite, and hydrogen-autunite(?). A new mineral which is apparently a sodium uranium phosphate has been studied, but is not completely characterized. Blockyness of the lignite favors U deposition. The minerals have no observed affinity to particular lignite macerals. The sodium-autunite is associated with lignites having a high solubility in water and dilute hydroxide solutions.

The U minerals in the Cave Hills and Billings County areas appear to have formed after removal by erosion of the overlying beds of volcanic material which are thought to have been the source of the U. This indicates that in these areas the U must have been precipitated originally in the lignite and subsequently leached and redeposited in near surface portions of the same or nearby seams. --Auth.

1-756. Weis, Paul L., Frank C. Armstrong, and Samuel Rosenblum. RECONNAISSANCE FOR RADIOACTIVE MINERALS IN WASHINGTON, IDAHO, AND WESTERN MONTANA: U. S. Geol. Survey, Bull. 1074-B, p. 7-48, 3 illus., table, 1958, pub. Jan. 1959, 50 refs.

About 50 occurrences of radioactive minerals and nearly 50 properties not abnormally radioactive were examined during geologic reconnaissance for radioactive minerals in Idaho, Washington, and western Montana during the period July 1952 to June 1955. The most important U deposits are in or near granitic to quartz monzonitic intrusions of probable Cretaceous age in central and northern Idaho, westernmost Montana, and northeastern Washington. These areas are considered to be most favorable for prospecting. Margins of granitic intrusive bodies in central Montana and western Washington may also be favorable. U-bearing pegmatites associated with granitic intrusive rocks are considered too small and too low grade to be potential sources of U. Some placer deposits in southern and central Idaho contain sufficient concentrations of U minerals to be of interest as a source of U.

Known thorite-bearing veins are confined to Precambrian rocks of the Belt series in northern and E.-central Idaho and southwestern Montana. Monazite-rich layers in metamorphic rocks in E.-central Idaho do not seem large enough and continuous enough to permit profitable mining. --Auth.

1-757. Stephens, James G., and M. J. Bergin. RECONNAISSANCE INVESTIGATION OF URANIUM OCCURRENCES IN THE SARATOGA AREA, CARBON COUNTY, WYOMING: U. S. Geol. Survey, Bull. 1046-M, p. 321-38, 7 illus., geol. map (in pocket), scale approx. 1:86,000, 4 tables, March 1959, 13 refs.

U occurs in the Browns Park(?) formation of Miocene(?) age, the North Park(?) formation of Pliocene(?) age, and Quaternary pediment gravels in the Saratoga area, Carbon County, Wyo. No commercial deposits have been found to date. Carnotite, $K_2(UO_2)_2(VO_4)_2$ 1-3H O, the only U mineral identified in the area, was found at 2 localities. It occurs in pediment deposits as a coating on individual cobbles and boulders and as disseminated specks in fine-grained material. Directly below the pediment gravel, carnotite is found as a caliche-like coating on limestone and sandstone. At 30 other localities the U is disseminated as a mineralogically unidentifiable form in chert, limestone, sandstone, siltstone, carbonaceous shale, or volcanic ash. The highest concentration of U (0.027%) was found in chert layers and irregular masses in silicified limestone. A concentration of 0.026% U was found in a silicified volcanic ash bed 0.4 ft. thick. A selected sample of pediment gravel containing carnotite analyzed 0.011% U.

The carnotite occurrences are believed to have been formed by solution and redeposition of U by ground water.

Analyses of rock and water samples collected in the area and generalized descriptions of exposed strata are tabulated. --Auth.

1-758. Friedman, Gerald M. THE SAMREID LAKE SULFIDE DEPOSIT, ONTARIO, AN EXAMPLE OF A PYRRHOTITE-PYRITE IRON FORMATION: Econ. Geology, v. 54, no. 2, p. 268-84, index map, geol. map, magnetic contour plat, table, March/Apr. 1959, 36 refs.

Many pyrrhotite and pyrrhotite-pyrite bodies, known to prospectors and geologists as "dikes," are being discovered in the Canadian Shield as a result of intensive geophysical prospecting. The Samreid Lake pyrrhotite-pyrite body [about 28 mi. NNE. of Blind River] was chosen to serve as a type example for this kind of deposit.

The area in which the sulfide deposit occurs was mapped in detail to determine the lithological relationship between the sulfide and the country rock. In the northern part of the area, the rocks are mostly amphibole-bearing and include amphibolites and amphibolitic tuffs with sporadic metatuffs and quartz siltites. These rocks are interbedded with minor flows. The southern part of the area is mostly underlain by metatuffs, quartz siltites, and quartzites in which amphibole is sporadic or absent. The amphibolites, quartz siltites, and quartzites have probably been formed from shale and argillaceous siltstone and sandstone. The location of the mineralized quartzite, the host rock of the sulfide body, roughly coincides with the contact between the amphibolitic and non-amphibole-bearing rocks. The mineralized quartzite is recrystallized chert. Lava flows are interbedded with the sulfide-bearing quartzite. Diabase dikes intruded the rocks of the area.

The essential minerals making up the sulfide body are pyrrhotite and pyrite. Abundant magnetite is intergrown with the sulfides; marcasite is rare. Chalcopyrite and cubanite were noted in minor amounts. The sulfide body is essentially barren of base-metal mineralization. Along part of the mineralized zone pyrite predominates, elsewhere pyrrhotite predominates or is the sole sulfide mineral. As a rule, however, pyrite and pyrrhotite occur together.

Magnetite is considered to have been precipitated in a marine environment. Deposition took place in an area of volcanic activity in which the clastic sediments were permeated by a gaseous network of H_2S. Locally precipitated iron hydroxide gels, and perhaps some magnetite, were converted to pyrite. At a post-geosynclinal orogenic stage in the history of the area, pyrrhotite is considered to have formed at the expense of pyrite. Geological thermometry points to a temperature of formation of 420 to 600° C. for these rocks. This temperature reflects post-depositional metamorphic conditions to which these rocks were exposed. --Auth.

1-759. Bates, Robert L. CLASSIFICATION OF THE NONMETALLICS: Econ. Geology, v. 54, no. 2, p. 248-53, 4 tables, March/Apr. 1959, 6 refs.

A rational classification is a prerequisite for the systematic study of the geology of the nonmetallics. Neither the conventional treatment of the subject in standard references, nor a strictly genetic classification, is considered satisfactory for this purpose. Several criteria, primarily economic, are set forth, by which the nonmetallics are subdivided into 2 major groups, the industrial rocks and the industrial minerals. Further subdivision within each group is on the basis of origin. A proposed classification is presented and briefly discussed. --Auth.

1-760. Stugard, Frederick, Jr. PEGMATITES OF THE MIDDLETOWN AREA, CONNECTICUT: U. S. Geol. Survey, Bull. 1042-Q, p. 613-83, 4 illus. (2 in pocket) incl. geol. map, scale 1:24,000, 16 tables, 1958, pub. Jan. 1959, 111 refs.

The pegmatites of the Middletown area in Connecticut have been mined almost continuously for feldspar and muscovite mica since about 1865. Pegmatites in this and other areas have recently become the subject of renewed interest because they are the potential source of beryl, the ore mineral of Be. From 1948 to 1950, the U. S. Geological Survey studied and mapped the pegmatites in an area of about 58 sq. mi. near Middletown. The primary objectives of the mapping were to determine Be resources of the Middletown area and to ascertain relations of beryl-bearing pegmatites to non-beryl-bearing pegmatites and to type of wall rock.

More than 330 concordant and discordant pegmatites were examined within the mapped area. The pegmatites cut the metasediments of the Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, the Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. The position of these formations in the stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatites, which have been dated by U- and Th-Pb ratios as about 260 million years old, presumably Mississippian.

The Bolton schist includes middle- to high-rank mica-quartz schist of various compositions interbedded with minor quantities of quartzite, diopside- and hornblende-bearing marble, and hornblende-bearing schist and gneiss. The mafic gneiss is predominantly hornblendic gneiss and schist with subordinate mica schist and light-colored feldspathic gneiss. These metasediments are cut by the Glastonbury granite gneiss, a gray to pink medium- to coarse-grained porphyritic gneiss; by the Maromas granite gneiss, a gray medium-grained biotite orthogneiss; and by the Monson gneiss, a banded to massive medium-grained biotite granodiorite gneiss.

The metamorphic rocks in the northern part of the Middletown area dip westward, but in the southern part the Bolton schist is bowed up by the Monson gneiss into a dome. Between these areas the rocks show evidence of intense folding and overturning. The western part of the area is covered by fanglomerate, conglomerate, sandstone, and siltstone of Triassic age, bounded by normal faults. An E.-trending fault of indeterminate age probably offset the metamorphic and igneous rock units in the area near Great Hill.

The pegmatites are composed essentially of perthite, quartz, plagioclase, and muscovite. The common accessories are tourmaline, beryl, garnet, and biotite. The pegmatites have been divided into 4 groups based on the content of plagioclase feldspar: those with less than 40% of plagioclase, with and without beryl; and those with more than 40% of plagioclase, with and without beryl. About 42% of the pegmatites contain more than 40% plagioclase, and 58% of them contain less than 40% of plagioclase.

Most of the pegmatites are nearly homogeneous bodies with a grain size from about 1 to 4 in. They have a finer grained border zone, 1 to 6 in. thick, with a mineral composition similar to the main part of the body. This type of pegmatite is of limited economic value. About 25% of the pegmatites, however, show a systematic variation in mineral composition from the walls inward. Units of differing mineralogic or textural characteristics are usually richer in perthite, albite, muscovite, or quartz. The grain size increases from the walls to the center of the pegmatite. As many as 5 distinct units, or zones, parallel to the pegmatite wall-rock contact have been noted in an individual pegmatite. In some pegmatites fracture-filling units of quartz and perthite cut the zones. No replacement units were recognized.

The ratio of concordant to crosscutting pegmatites is almost 3:1. The pegmatites appear unaffected by regional metamorphism, but they have deformed their wall rocks. The wall rocks have been altered near the pegmatites by the addition of tourmaline, muscovite, albite, and beryl.

The total resources of beryl, sheet and scrap muscovite, and feldspar are unknown because of poor exposures and limited development. Feldspar reserves are adequate to continue mining on the present scale for many years. No beryl deposits capable of sustaining an operation for beryl alone have been discovered, but rock containing 0.1% beryl or more is available in sufficient quantities for milling if future technical development makes its use desirable. Additional sheet and scrap mica can be produced profitably only if prices are much higher than during World War II. --Auth.

1-761. Furcron, A. S., and Eugene C. Perry, Jr. LIMESTONES OF LEE COUNTY, GEORGIA: Georgia Mineral Newsletter, v. 11, no. 4, p. 111-18, 6 illus., 4 maps, Winter 1958.

Lee County, in southwestern Georgia, is underlain by Eocene and Oligocene limestones, whose outcrops are frequently associated with sinks. More desirable occurrences are probably limestone beds with shallow, loose overburden, which are found some distance from large streams. Although the only limestones quarried at present are the deposits operated by the Albany Limerock Company, near Armena, the widespread occurrence of limestone in this county indicates a potential expansion of the limestone industry here.

Fourteen analyses of limestone are given with descriptions of the properties from which they were taken. These analyses indicate a uniformly excellent quality. Calcium carbonate percentages are high; magnesium carbonate percentages are low. This high lime-low magnesia content makes the limestone favorable for use in Portland cement or as agricultural lime. The hardness of the limestone is sufficent for its use in highway and other construction projects. --G. E. Denegar.

1-762. Quebec (Province), Dept. of Mines. THE MINING INDUSTRY OF THE PROVINCE OF QUEBEC IN 1957: 147 p., 8 illus., fold. map, 3 graphs, 64 tables, Quebec, Queen's Printer, 1959.

In 1957, the value of the mineral production of the Province of Quebec totalled $443,808,980, a decrease of 4.28% from the record high attained in 1956. Most of the decrease is attributable to a general decline in metal price and production of 6 of the 13 metals produced in the Province. The value of both industrial-mineral and building-material production increased.

Lower base-metal prices were reflected in fewer prospecting, staking, and development activities. The number of mining titles issued in 1957 was less than the total for 1956. Renewals of development licenses reached a 12-year high.

The report also contains details on the operations and developments in the mining industry and statistics on employment, salaries, and accidents. A short description, illustrated with a map, of a vast project to move part of the town of Thetford Mines is given.

This report was prepared by Edgar E. Bérubé, in collaboration with engineers and geologists of the Department. --G. E. Denegar.

1-763. Sorensen, Harry O., and Emery T. Carlson. MICHIGAN MINERAL INDUSTRIES 1957: Michigan, Geol. Survey Div., 92 p., 3 maps, columnar sec., graphs, tables, Dec. 1958.

A general review of Michigan's mineral production, including Fe ore and Cu; petroleum, natural gas, and natural gasoline; portland cement, salt, natural salines, sand and gravel, stone, clay and shale, gypsum, lime, peat, marl, and gem stones; water.

The 1958 production is compared graphically with 1957 and 1956. Maps show locations of rock and mineral developments and mineral industries, petroleum and natural gas production, sand and gravel production.

Production statistics and value of minerals and mineral products are also given by counties. Included is a directory of producers of minerals and mineral products. Late developments are outlined, and the general geology of Michigan is reviewed. --G. E. Denegar.

1-764. Griess, Phyllis R., and George F. Deasy. SOME EFFECTS OF NATIONALIZATION ON THE BOLIVIAN TIN MINING INDUSTRY: Mineral Industries, v. 27, no. 7, p. 2-3, map, Apr. 1958, 5 refs.

In Oct. 1952, the Bolivian government nationalized all large tin mines and expropriated their properties and assets. Operation of the seized mines was entrusted to a political entity, the Bolivian Mining Corporation. Policies established by this governing body caused repeated unjustifiable increases in miners' wages, unwarranted expansion of the mine labor force, a breakdown in labor discipline, an exodus of competent administrators and technicians, a diversion of profits from mine maintenance and ore exploratory work, and an over-ambitious social security program for the miners.

The effects of nationalization on Bolivia's tin mining industry since 1952 have been drastic: (1) Bolivian tin production has fallen markedly; (2) one-half of the large mines no longer are being operated at a profit; (3) known reserves of tin ore at most mines have shrunk to the danger point; (4) the tin content of ore being produced at the mines has declined sharply.

Unless the present trend is reversed, the future will witness major decreases in Bolivia's mineral output, not only of tin but also of most other minerals obtained from the tin mines. --P. R. Griess.

1-765. Miller, E. Willard. LORRAINE: METALLURGICAL CENTER OF FRANCE: Mineral Industries, v. 28, no. 1, p. 1-6, 4 maps, Oct. 1958.

Lorraine, in eastern France, is the major metallurgical center of the nation. In recent years, this region has produced about 96% of French iron ore, 79% of the pig iron, 69% of the steel, and 63% of the finished iron and steel products. Besides this dominant role in France's iron and steel industry, Lorraine also plays a significant part in the larger metallurgical complex of Western Europe. The competition between Lorraine and the Ruhr has often been of major importance in shaping the political policies of France and Germany. This is a fairly exhaustive study of the trends of the iron and steel industry of France since 1870. The study is based on both library and field work in France. --Auth.

1-766. Schanz, John J., Jr. THE SOVIET MINERAL ECONOMY - PRESENT AND POTENTIAL: Mineral Industries, v. 27, no. 5, p. 1, 4-6, 8, illus., Feb. 1958.

The Soviet Union's resource base is a subject of considerable significance. Any industrial complex that the Russians might wish to create can be neither larger nor any more durable than the natural-resources foundation that supports it. Despite the limited information released by Russia on its mineral industries, or their attempts to obscure their mineral-resources position, it is possible utilizing this information and a general knowledge of Soviet geology to arrive at a fairly good picture of the Soviet mineral potential.

The Soviet Union is still second to the United States in terms of actual production. Despite the rapidity of Russia's expansion in the past, it will require an even greater effort in the future to catch up to the United States because of the increasing absolute size of the growth increments. With lower civilian requirements, the Soviet Union can be as powerful militarily as the United States with a smaller production of minerals.

In terms of specific mineral commodities, Russia's weaknesses are few and not too serious. Nonferrous metals are not produced in as large quantities as in the United States, but this cannot be classed as a real shortage. Rock-products production, such as cement, chemicals, and fertilizers, will have to be expanded. There may be shortages in some of the strategic nonmetallic minerals. The big problems, however, are the location of mineral deposits, the adequacy of the Soviet transportation system, the total size of their working population, and the lack of skilled workmen for production supervision. --Auth.

13. FUELS

See also: Geologic Maps 1-550, 1-566, 1-568, 1-575, 1-583; Structural Geology 1-645; Stratigraphy 1-658, 1-659.

1-767. Chew, Ju-Nam, and Carl A. Connally, Jr. A VISCOSITY CORRELATION FOR GAS-SATURATED CRUDE OILS: Am. Inst. Mining, Metall. & Petroleum Engineers, Petroleum Trans., Tech. Paper 8050; pub. in: Jour. Petroleum Technology, (insert between p. 72-72A), 2 graphs, 4 tables, Feb. 1959, 3 refs.

A correlation is presented for predicting the viscosity of gas-saturated crude oils under reservoir conditions. It is based on the dead oil viscosity and the solution GOR. The correlation was developed from a study which showed that at a fixed solution GOR, the relation between the gas-saturated oil viscosities and the corresponding dead oil viscosities is a straight line on logarithmic coordinates.

Data from 457 crude oil samples from the major producing areas of the U. S., Canada, and South America were used. The best straight lines through the data were fitted by the method of least squares with a digital computer. The correlation is presented in the form of an equation and also in a convenient graphical form. --Auth.

1-768. Hodgson, Gordon W., and Bruce L. Baker. GEOCHEMICAL ASPECTS OF PETROLEUM MIGRATION IN PEMBINA, REDWATER, JOFFRE, AND LLOYDMINSTER OIL FIELDS OF ALBERTA AND SASKATCHEWAN, CANADA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 311-28, 6 figs. incl. maps, graphs, 8 tables, Feb. 1959, 18 refs.; also pub. as: Research Council Alberta, Contr. no. 80.

The chemical character of the crude oils produced throughout 4 major fields and several minor fields in western Canada has been studied. The variations in Ni and V content appear systematic and are undoubtedly a key to the accumulation history of the oils. The metal variations run parallel for the most part to variations in S, resins, and asphaltene content of the oil as well as to the gravity, and are apparently sensitive indicators of crude-oil alteration. The Pembina field is the most interesting because the magnitude of the variations from point to point in the field are very large - about ten-fold for the metals. Much smaller variations are noted for the other fields, and this may be a result of the smaller sizes of those fields. If the data are interpreted in the light of probable adsorption alteration during accumulation and probable source conditions, the Pembina-Cardium oil apparently accumulated in the Cardium sands in a direction away from the present updip edge at the NE.; the Redwater oil, from downdip toward the S.; the Viking Joffre oil, from downdip at the SW.; and the Lloydminster oil pools, from very local source rocks. --Auth.

1-769. Bell, W. A. POSSIBILITIES OF OCCURRENCE OF PETROLEUM RESERVOIRS IN NOVA SCOTIA: Nova Scotia Dept. Mines, [Pub.], 177 p., 5 illus., index map, 1958, 121 refs.

This report is essentially a review of the Carboniferous geomorphology of Nova Scotia from the viewpoint of occurrence of possible favorable environments and deposition of sediments suitable for petroleum formation and storage. Unpublished maps and reports of oil geologists who were engaged in exploration for petroleum in the province were extensively utilized by the author. Oil companies have been particularly interested in systematic exploration for petroleum in Nova Scotia following the discovery of oil and gas in the Albert formation of the Mississippian Horton group in adjoining southeastern New Brunswick, and their activities up to the present have been almost exclusively directed to the Horton group. No attention has been paid to pre-Carboniferous sediments owing to induration or metamorphism brought about during the Acadian disturbance in Devonian time.

The author thinks that Carboniferous deposits were laid down in Nova Scotia in four major sub-basins of deposition within a regional Fundy geosynclinal area. These four, viz. Cumberland, Minas, Antigonish-Ainslie, and Sydney are considered to have been more or less separated from one another by linear, intermittently uprising Carboniferous uplands. With exception of the late Mississippian Windsor group the sediments are all classified as non-marine and as fluvial and fluviolacustrine. Some of the lacustrine deposits were definitely laid down in brackish water, but present evidence provides no support for postulation that any of these non-marine deposits grade into, or interfinger with marine deposits within the present land area of Nova Scotia; the deposits are essentially sub-limnic in character. Lacustrine beds and members are considered by the author to be the only favorable one-time source rocks for petroleum within the non-marine groups. They are too thin in the aggregate to have any significance in petroleum geology in all groups of the Pennsylvanian except the Stellarton group, which has a thick lacustrine member that contains many thin zones of torbanitic shales. Petroliferous sandstone was discovered in this member by recent drilling, and free petroleum is inferred to have formed in addition to pyrobitumens. Pyrobituminous shales as distinct from lacustrine shales rich in carbonaceous matter are rare and thin in the Horton group of Nova Scotia in areas of outcrop, and, if any thick pyrobituminous formation similar to the Albert occurs, it probably lies under too thick a cover of later rock to be economically explored.

The marine Windsor group is characterized throughout Nova Scotia by occurrence within it of many beds of bituminous limestone, and, although these are generally individually thin, the author thinks that the Windsor should be given more attention in further petroleum exploration. The number and thickness of evaporite deposits would make exploration costly in all sub-basins except the Sydney one. There evaporite deposits are restricted to one zone and do not furnish evidence of transfer to salt anticlines or of diapiric piercement as in the other sub-basins. Moreover, the Windsor sequence at Sydney contains more interbedded clastic deposits in addition to dolomitic limestones, which might well be regarded as potential reservoir rocks. If a favorable closed anticlinal structure were found in the Sydney area where the whole of the Windsor group was covered by later strata it would provide an ideal site for testing the group for petroleum content. If this resulted in a favorable discovery, exploration of the Windsor group in other sub-basins might prove to be justifiable. --Auth.

1-770. Jordan, Louise. UNDERGROUND STORAGE IN SALT, ELK CITY FIELD: Oklahoma Geol. Survey, Oklahoma Geology Notes, v. 19, no. 2, p. 32-34, diag., Feb. 1959, 4 refs.

In 1953 the Shell Oil Company decided to supplement its storage tanks at the Elk City processing and gas cycling plant, Beckham County, Oklahoma, by washing out a cavity in a salt bed of the Blaine formation (Permian). Additional storage of 16,000 barrels was provided at considerable saving compared with cost of above-ground storage.

On Aug. 2, the Company's No. 1-LPG Yelton was spudded. Coring was continued to a total depth of 1420 ft., and a complete rock section was recovered. The hole was plugged back to 1413 ft. In late Aug., fresh water was circulated into the salt layer at a depth of 1360-1411 ft., dissolving the salt and forming an underground cavern. The storage space was ready by Jan. 1954. The reservoir is filled by pumping propane in and displacing the salt water into a storage tank. Propane is withdrawn by gravitating salt water from the surface down the tubing.

The rock section indicates that the base of the Blaine formation would be penetrated at 1600 ft. and that an evaporite section of at least 475 ft. exists in this area. The Blaine formation cropping out in southwestern Oklahoma ranges in thickness from 130-200 ft. Westward it thickens by the addition of gypsum at the top, and eastward it becomes indistinguishable from the Dog Creek and Flowerpot formations (Permian) by gradation into shale. The upper boundary is one of gradation with the Dog Creek shale, here about 90 ft. thick, for which a saline environment is indicated. --A. C. Sangree.

1-771. Lytle, William B., John M. Bergsten, Addison S. Cate., and W. R. Wagner. OIL & GAS DEVELOPMENTS IN PENNSYLVANIA IN 1958: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 155, 44 p., 4 figs., 6 pls., 8 tables, 1959.

Pennsylvania had an outstanding year in deep (Middle Devonian or older) exploration for oil and gas. During the year there were 2 successful new field wildcats completed, 8 successful new pool wildcats, including one found by drilling deeper an old well, and 5 successful outpost wells. One hundred nineteen deep wells were completed in Pennsylvania in 1958, with a total footage of 827,443 ft. Six reactivated wells drilled 330 ft. Of the 119 wells, 75 were gas wells, 2 were oil wells and 42 were dry holes.

The shallow-sand (Upper Devonian or younger) territory of western Pennsylvania had 2 new pool discoveries. Shallow-sand drilling activity decreased in 1958 over that of 1957. In all, 668 shallow-sand wells were completed. Of these, 258 were gas wells, 24 were oil wells, 46 were dry holes, and 5 were drilled for underground gas storage. Three hundred and thirty-five were drilled in connection with secondary-recovery oil operations. The total footage for the new and deepened wells was 1,511,911 ft. As in 1957, the secondary-recovery projects in the Bradford field and development drilling in the gas fields dominated the shallow-sand drilling activity during 1958.

Oil production decreased from 8,210,000 bbls. in 1957 to 6,471,680 bbls. in 1958. Pennsylvania's proven oil reserves were estimated at 120,018,000 bbls. as of Dec. 31, 1958. Gas production increased from 107,004,000 MCF in 1957 to an estimated 115,000,000 MCF in 1958. The total footage drilled, both shallow and deep, was 2,339,684 ft. --Auth.

1-772. Kaufmann, Godfrey F. PRODUCTIVE AND PROSPECTIVE PETROLIFEROUS ZONES WITHIN TECTONIC FRAMEWORK OF JAPAN AND ADJACENT AREAS: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 381-96, 9 figs. incl. maps, diags., Feb. 1959, 15 refs.

The tectonic framework of the NW. quadrant of the circum-Pacific orogenic belt is explained as the result of the process postulated in the theory of growing continental masses. The festoons of island arcs marked by the Nampo Shoto, Northern Japan, the Kuriles, Kamchatka, and the Aleutian Islands are the most recent additions to the northeastern part of the Asian continent and have resulted from late Mesozoic and Tertiary orogenies. Japan and Kamchatka are polycyclic orogenic mountain arcs and were part of older festoons of island and mountain arcs extending from Kamchatka through Formosa and the Philippines. Early orogenic movements can be traced in Japan in the late Devonian, Carboniferous, and middle Permian. The present forms and positions of the Japanese islands were probably defined during early Mesozoic orogenies.

In narrow, coastal areas of NW. Honshu, western Hokkaido, and SW. Sakhalin, small production of oil and gas is obtained from Upper Tertiary formations on folded and faulted structures fringing the mobile side of the Japan Sea sedimentary basin. In northeastern Sakhalin, more substantial oil production is obtained from Tertiary beds where structural and stratigraphic conditions suggest that the accumulations occur on the present, more or less stable side of the Okhotsk Sea idiogeosynclinal basin.

New, and perhaps important, oil discoveries can be expected from structural folds located off the NW. coasts of Honshu and Hokkaido, and perhaps off the SW. coast of Sakhalin. Some oil may be found in small intramontane type basins in central and NW. Hokkaido. Additional production should be found in structural or stratigraphic traps off the NE. coast of Sakhalin. --Auth.

1-773. Arabian American Oil Company Staff. GHAWAR OIL FIELD, SAUDI ARABIA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 434-54, 8 figs. incl. maps, diags., 2 tables, Feb. 1959, 2 refs.

Ghawar field is located about 50 mi. inland from the western shore of the Persian Gulf, in Hasa Province, Kingdom of Saudi Arabia.

The field was discovered in 1948 by a wildcat well at Ain Dar. Other wildcats, Haradh (1949), 'Uthmaniyah (1951), and Shedgum (1952), proved to be on subsidiary closures of the same great anticline and parts of the same oil field. Oil-finding has been primarily through structure drilling, although surface mapping furnished initial clues and gravity mapping proved helpful.

The oil field is a structural accumulation along at least 140 mi. of the N.-S.-trending En Nala anticlinal axis. The fold is simple in the S., develops 2 low marginal crestal closures in the center, and is subdivided into 2 adjacent anticlines in the N. Seven crestal closures have been found, but oil appears to be continuous from Ain Dar [25°59'N. 49°23'E.] to Haradh [24°08'N. 49°05'E.].

Ghawar oil is Upper Jurassic, occurring in the shallow-water carbonate sediments of the upper Jubaila and lower Arab formations. It is confined above by the lowest of the 3 anhydrite members of the Arab formation. Only minor shows of oil have been found in higher parts of the Arab. The most prolific production is derived from calcarenites in which much original pore space survives. Other rocks making up the reservoir are fine-grained limestone, calcarenitic limestone, dolomitic limestone, and dolomite. Partial dolomitization, usually porphyroblastic, is extensive.

The oil accumulation, conservatively estimated at 875 sq. mi. in area, has a maximum vertical oil column of about 1,300 ft. Gravities range from 36° API in the N. to 33° API in the S. The crude is undersaturated, with saturation pressures decreasing to the S.

The oil-water contact rises to the S. The reservoir water ranges from 240,000 ppm. total solids in the N. to 38,000 ppm. in the S. On the W. side of the structure elevations of the contact are higher, and salinities of the water are lower than on the E.

Incipient growth of the Ghawar structure apparently started in the Lower Cretaceous, but the structure in its present form first became apparent in truncation at an unconformity between the early and late Upper Cretaceous (roughly post-Cenomanian and pre-Maastrichtian). Growth continued into the middle Eocene with minor disturbances possibly continuing to the Miocene. No fundamental structural disturbance, except perhaps regional tilting, seems to have taken place during and after Miocene time.

The source of Ghawar oil apparently is in the Arab and Jubaila formations. The oil volume forces an assumption of substantial lateral migration. Temporary accumulation of the oil in a stratigraphic trap prior to its localization in the present oil field is the preferred hypothesis. --Auth.

1-774. Playford, P. E., and M. H. Johnstone. OIL EXPLORATION IN AUSTRALIA: Am. Assoc. Petroleum Geologists, Bull., v. 43, no. 2, p. 397-433, 8 figs. incl. 6 maps, 2 cross-secs., 14 tables, Feb. 1959, 19 refs.

In the past 5 years, oil exploration in Australia has been greatly accelerated, but no commercial fields have been discovered. Exploration has been most intense in Western Australia, though active work has been carried out in every other Australian state except Tasmania.

Precambrian sedimentary, metamorphic, and intrusive rocks cover a large part of Australia. During the Paleozoic, a huge volume of sediments accumulated in the great Tasman geosyncline, along the eastern side of the present Australian continent. The geosyncline underwent several major orogenies, the last of which occurred in the late Permian. Since then the continent has been remarkably stable, without any widespread orogenic movements. The pre-Permian sediments of the Tasman geosyncline are generally regarded as basement in oil exploration as they are metamorphosed and intensely deformed.

In the central and western parts of the continent, the Precambrian shield is overlapped by a series of basins containing Cambrian and younger sediments. In eastern Australia, similar basins overlie basement rocks of the Tasman geosyncline, and contain Permian and younger sediments. These basins show relatively mild deformation, and several are regarded as prospective in oil exploration. The Carnarvon and Canning basins in Western Australia are believed to contain thicker prospective sedimentary sequences, and consequently are likely to have better oil prospects, than the other sedimentary basins of Australia. For this reason, they have recently received most attention in oil exploration. However, several other basins are regarded as promising and are being tested by Australian and overseas companies.

The only bore drilled in Australia which has produced a significant flow of oil is West Australian Petroleum's Rough Range No. 1 in the Carnarvon Basin. However, the oil accumulation beneath this well is believed to be too small for commercial exploitation. Shows of oil have been reported from bores in several other Australian sedimentary basins, but these have not been followed by discoveries of commercial value. --Auth.

1-775. Maher, T. P. DETERMINATION OF ACIDIC GROUPS IN COAL TARS BY NON-AQUEOUS TITRATION: Illinois, State Geol. Survey, Circ. 264, 8 p., 4 figs., 4 tables, 1959, 4 refs.

The acidic groups in tars obtained by low-temperature carbonization of a high-volatile C bituminous coal at different temperatures up to 600°C. were determined by titration with sodium aminoethoxide in ethylenediamine. All the titration curves showed 3 inflections, but it was thought that the first 2 were caused by groups of the same general acidic strength. Apart from the small yield of tar of low acidity obtained at 350°C., the acidity was found to decrease from 5.66 milliequivalents per gram at 400°C. to 4.64 milliequivalents per gram at 500°C. and then increase again to 5.74 milliequivalents per gram at 600°C. The component acidities followed the same trend, and the ratio of strongly acid groups to weakly acid groups increased with increase in the carbonization temperature. --Auth.

1-776. Norris, D. K. STRUCTURAL CONDITIONS IN CANADIAN COAL MINES: Canada, Geol. Survey, Bull. 44, 54 p., illus., 12 figs. (4 in pocket), 2 pls., 1958, 29 refs.

In order to develop criteria that may assist the coal-mining industry to establish safe and economical deep-mining practices, a detailed examination was made of geological structures encountered underground in coal mines in the eastern part of the Canadian Cordillera and in Nova Scotia. In the former area, the coal seams are in most instances highly sheared and are cut by a profusion of faults, the ratio of normal to reverse being about 10 to one. In the seams of the latter area, the coal is relatively undisturbed and is cut by few normal faults and practically no reverse faults. The fact that both normal and reverse faults show a preferred orientation with respect to the bedding would indicate that the layering in the rocks influenced the spatial distribution of the principal stress trajectories as the coal measures were being deformed. Faults, folds, and pinch outs were not found to be a controlling factor in violent relief of stress but rather mining practice and the strength of the coal and rocks adjacent to the mine cavity. Thus, in friable and sheared coals, violent stress phenomena occur at shallow depths, and it is anticipated that in Cordilleran mines the maximum depth at which coal may be safely mined under existing practices is about 2,500 ft., and in Appalachian mines, about 4,500 ft. --Auth.

1-777. Barnes, Farrell F., and Daniel Sokol. GEOLOGY AND COAL RESOURCES OF THE LITTLE SUSITNA DISTRICT, MATANUSKA COAL FIELD, ALASKA: U. S. Geol. Survey, Bull. 1058-D, p. 121-38, 8 illus. (5 in pocket) incl. geol. map, scale 1:63,360, Feb. 1959, 2 refs.

The Little Susitna district of the Matanuska coal field lies along the northern border of the lower Matanuska Valley in S.-central Alaska. The Alaska Railroad at the W. end of the district, and graveled roads leading to its S., E., and W. edges, make the district easily accessible.

Three bedrock formations are known in the district. The oldest is mica schist, probably Precambrian, that was found in a small area; the second is the Arkose Ridge formation, consisting mainly of arkosic sandstone of probable Cretaceous age; and the youngest is an unnamed formation, probably Eocene in age, consisting of sandstone, siltstone, and claystone and including several beds of subbituminous coal. Except for a few outcrops along the larger streams, the district is entirely mantled by unconsolidated Quaternary deposits of glacial and alluvial origin.

The coal-bearing strata generally dip gently southward but are locally folded and faulted. They contain several beds of subbituminous coal, mostly less than 3 ft. thick but including one impure bed at least 9 ft. thick. Surface mapping in 1952 indicated that 4 localities, in addition to the Houston area where coal has been mined intermittently since 1917, contain one or more beds of potential stripping coal. Exploration of these 4 localities with a bulldozer and power auger in 1953 and 1954 indicated that the coal generally is too thin or impure to encourage mine development under present conditions. In the Houston area, diamond drilling by the U. S. Bureau of Mines in 1951 and 1952 showed that the upper 1,200 ft. of the coal-bearing formation contains no more than 2 beds with as much as 3 ft. of coal, and that these thin abruptly away from the outcrop. --Auth.

14. ENGINEERING GEOLOGY

See also: Geologic Maps 1-555, 1-558, 1-559, 1-563; Stratigraphy 1-658, 1-659; Miscellaneous 1-799.

1-778. Scharon, LeRoy, Robert Uhley, and Tsvi Meidav. SUBSURFACE INVESTIGATIONS OF A PLANT SITE: Mining Engineering, v. 11, no. 2, p. 215-19, 7 figs. incl. isopach map, charts, Feb. 1959, 10 refs.

Before construction of an industrial plant on property of National Lead Company in Fredericktown, Missouri, some 100 mi. S. of St. Louis, subsurface investigations were made of the proposed site. These investigations, consisting of electrical resistivity, seismic refraction, and churn drilling techniques, were confined to an area of 750 by 500 ft. The purpose of accumulating these data were to: (1) prepare an isopach map of the thickness of the overburden; (2) determine depth to bedrock at fixed points; and (3) determine soundness of the dolomite bedrock. --Auth.

1-779. U. S. Waterways Experiment Station, Vicksburg, Miss. GEOLOGY OF THE MISSISSIPPI RIVER DELTAIC PLAIN, SOUTHEASTERN LOUISIANA, by Charles R. Kolb and J. R. Van Lopik: Its: Tech. Rept. no. 3-483, 2 v.: v. 1, text, 31 figs. incl. illus., maps, charts, secs., diags., graphs, 4 tables; v. 2, plates (27 maps and secs.), July 1958, 132 refs.

Environments of Recent deposition of the deltaic plain of the Mississippi River are classified from the standpoint of their associated engineering soil types as follows:

- Fluvial
  - natural levee
  - point bar
  - abandoned course
  - abandoned distributary
- Fluvial-marine
  - prodelta
  - intradelta
  - interdistributary
- Paludal
  - marsh
    - saline-brackish
    - brackish-fresh
    - flotant
    - fresh
  - swamp
    - inland
    - mangrove
  - tidal channel
  - lacustrine
- Marine
  - bay-sound
  - reef
  - beach
    - sand
    - shell
  - nearshore gulf

The processes active within each environment, the soil types associated with each, their distribution, and their physical properties are described, graphically illustrated, and/or delineated on maps. The sequence of geologic events that shaped the deltaic plain is outlined.

Subsidence, an important factor in deltaic plain morphology, is discussed. It varies from more than 5 ft. per century within the present Mississippi River delta to less than 2 ft. per century at the shoreline of the remainder of southeast Louisiana. --Auth. summ.

15. MISCELLANEOUS

1-780. Resources for the Future, Inc. PERSPECTIVES ON CONSERVATION; ESSAYS ON AMERICA'S NATURAL RESOURCES, by John Kenneth Galbraith [and others]. Edited by Henry Jarrett: 260 p., Baltimore, Johns Hopkins Press, 1958, refs.

Material in this book was first presented at Resources for the Future Forum held in Washington, D. C., during the first 3 months of 1958.

The essays, designed to shed light on some of the resource conservation problems of the next 50 years from the vantage point of a critical review of the past 50, are organized into 6 sections: 1) The First Fifty Years, by Ernest S. Griffith, Samuel T. Dana, Henry C. Hart, and Samuel P. Hays; 2) Science, Technology, and Natural Resources, by Thomas B. Nolan, Byron T. Shaw, Robert C. Cook, and Harry A. Curtis; 3) Resource Demands and Living Standards, by John Kenneth Galbraith, Philip M. Hauser, and Paul B. Sears; 4) Urban Growth and Natural Resources, by Luther Gulick, Joseph L. Intermaggio, Sigurd F. Olson, and Abel Wolman; 5) Some Determinants of Resource Policy, by Edward S. Mason, Robert W. Hartley, Minor S. Jameson, Jr., and Bushrod W. Allin; and 6) Organizing for Conservation and Development, by Gilbert F. White, Charles M. Hardin, Robert E. Merriam, and William Pincus. --G. E. Denegar.

1-781. Rickaby, H. C. CO-ORDINATION OF GEOLOGICAL SURVEYS IN CANADA: Royal Soc. Canada, Trans., Sec. 4. Geol. Sci., 3d ser., v. 52, p. 1-4, June 1958.

Relationship between the Geological Survey of Canada and the geological branches of the provinces has been satisfactory, although there has not been a clear understanding of the fields in which each of the groups are to operate.

As of Feb. 1958, the staff of the Geological Survey of Canada numbered 127 professionals, of which 105 were engaged in field studies. The Survey must at present spend much of its effort on the Yukon and Northwest Territories as it is the only government agency for geological work there. Administration of Indian lands and national parks is also under its direction. Expansion of the Survey was strongly recommended by the Royal Commission on Canada's Economic Prospects in 1956, so that mapping and survey may be increased.

All provinces except Prince Edward Island have set up geological branches. First-hand detailed geological information is necessary for administration of mining lands owned by the provinces. In Ontario, and probably in other provinces, certain types of geological work have been done by the federal survey, others by the provincial surveys. A statement of aims and policies of federal and provincial surveys would serve to clarify respective fields of responsibility. In any scheme of national planning for coordinated geological studies, the place and contribution of private companies should also be taken into consideration. A request to the government for an organization for national planning should be initiated by Section IV of the Royal Society of Canada. --A. C. Sangree.

1-782. Oppenheim, Victor. **EXPLORATIONS - EAST OF THE HIGH ANDES (FROM PATAGONIA TO THE AMAZON): 267 p., illus., maps, New York, Pageant Press, Inc., 1958, refs.**

A popular account of expeditions undertaken by the author in the capacity of professional engineer and consulting geologist for South American governments, mining and petroleum companies through Argentina, Bolivia, and Peru. Observations on Indian life, revolutions in Latin American capitals, wildlife, vegetation, and outstanding physical features encountered in geologic investigations are recorded. The possibilities of oil occurring in Bolivia and northern Argentina are discussed, also explorations for gold, diamonds, and other minerals, and the history of the area from pre-Columbian times to the present. --G. E. Denegar.

1-783. Powell, John Wesley. **THE EXPLORATION OF THE COLORADO RIVER. Abridged from the First Edition of 1875, with an Introduction by Wallace Stegner: 138 p., illus., Chicago, University of Chicago Press, 1958.**

On May 24, 1869, Major Powell's exploration of the Colorado River formally began. The party of 10 men followed the river from Green River City to Flaming Gorge, to the Gate of Lodore and its canyon there, from Echo Park to the mouth of the Unita, to the junction of the Grand and Green rivers, to the mouth of the Little Colorado, and finally through the Grand Canyon. The Rio Virgen and its canyon was also explored. The book contains descriptions of physical features encountered, equipment used, Indian tales of the Colorado, accounts of narrow escapes, etc. This nonscientific narrative of the exploration has long been out of print. This edition is based on Powell's original report. Scientific results are omitted. --G. E. Denegar.

1-784. Smith, Ollie, Jr. **WATER WITCHING: Tennessee, Dept. Conserv., Div. Water Resources, Inf. Circ. no. 1, 4 p., 1959, 3 refs.**

The first published description of water witching is attributed to Agricola (De Re Metallica) in 1556. Since then, the practice has continued everywhere, under many names and with many techniques, usually employing a "rod," and with some success. However, there are many basic fallacies which should be considered in evaluating this form of well location. Among these are: (1) regional ground-water conditions can be such that in 50% of wells drilled water would be automatically encountered; (2) most water witches have a working knowledge of the area and could leave the dramatic rod at home; (3) there is no scientific or logical basis for the attraction of wood by water; (4) the public seldom hears of failures, but often of successes. The State of Tennessee through the Division of Water Resources offers the service of ground-water information. --G. E. Denegar.

1-785. Canada, National Advisory Committee on Research in the Geological Sciences. **EIGHTH ANNUAL REPORT 1957-58 (INCLUDING SURVEY OF CURRENT RESEARCH IN THE GEOLOGICAL SCIENCES IN CANADA, 1957-58): 165 p., Ottawa, Geological Survey of Canada, Dec. 1958.**

The first part of the report (p. 1-6) summarizes work of the Committee during the period Sept. 1, 1957 - Aug. 31, 1958. Subjects covered include: status of the proposed comprehensive study of ore deposits; research grants to Canadian universities; publication of the Glacial Map of Canada in early 1958; publication of the first two numbers of Canadian Mineralogist in 1957 and 1958; removal of the Geological Survey Library from the Victoria Memorial Museum in Ottawa to a new building in 1959; translations for foreign geological literature available in Canada, Great Britain, and the United States.

The second part (p. 6-63) contains reports of the subcommittees on physical methods applied to geological problems; mineralogy, geochemistry and petrology; stratigraphy, palaeontology, and fossil fuels; pleistocene geology.

Two appendices (p. 64-76) list (1) summary reports on research projects completed or in progress under Geological Survey of Canada research grants; (2) Geological Survey of Canada research grants to Canadian universities 1958-1959, with brief descriptions of projects.

A bibliography, "Current Research in the Geological Sciences in Canada, June 1957 - May 1958," compiled by J. F. Henderson, occupies p. 77-164. In the bibliography, projects are classified under subject headings covering the main branches of geology. An author index is provided. The list of projects was obtained from universities, federal and provincial departments of mines, and other non-industrial institutions. It does not include research by mining and oil companies. Most of the projects are briefly described. --A. C. Sangree.

1-786. Rand, John R. **FIRST SUPPLEMENT TO BIBLIOGRAPHY ON MAINE GEOLOGY 1836-1957: 1836-JANUARY 1, 1959: Maine Geol. Survey, 10 p., Jan. 1959.**

This pamphlet contains cross-indexed references to 55 publications, papers, and articles dealing with geologic subjects in Maine. The pamphlet supplements the 143 p. Bibliography on Maine Geology 1836-1957 (pub. Jan. 1958), by listing older references not included in the Bibliography, and by presenting references to publications released since publication of the Bibliography. The pamphlet is sized to glue inside the back cover of the Bibliography.

In four parts: I. 1836-1930; II. 1931-1954; III. 1955-Sept. 1957; IV. Oct. 1957-Dec. 1958. --Auth.

1-787. Weld, B. A., E. S. Asselstine, and Arthur Johnson. **REPORTS AND MAPS OF THE GEOLOGICAL SURVEY RELEASED ONLY IN THE OPEN FILES, 1957: U. S. Geol. Survey, Circ. 403, 10 p., 1958.**

Maps and reports released by the Geological Survey in 1957 that are available only in the open files in Washington, D. C., in Geological Survey field offices, or in the offices of cooperating agencies. --U. S. Geol. Survey.

1-788. Anon. **LITERATURA PO GEOLOGII I SMEZHNYM DISTSIPLINAM, POSTUPIVSHAYA**

V BIBLIOTEKU OTDELENIYA GEOLOGO-GEOGRAFICHESKIKH NAUK AN SSSR APREL 1958 G. [LITERATURE ON GEOLOGY AND RELATED DISCIPLINES RECEIVED BY THE LIBRARY OF THE SECTION OF GEOLOGICAL-GEOGRAPHICAL SCIENCES OF THE ACADEMY OF SCIENCE OF THE U.S.S.R. IN APRIL 1958]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 7, p. 107-16.

The list contains 125 references to Soviet articles published in various periodicals and received by the library in Apr. 1958. The articles are categorized as follows: geology - 40 articles; paleontology - 10 articles; petrography, mineralogy, crystallography and geochemistry - 34 articles; mineral deposits, methods of prospecting and research - 24 articles; hydrogeology and engineering geology - 7 articles; miscellaneous - 12 articles. Fifty-six new Soviet and 33 foreign books were received by the library in Apr. 1958.--LC.

1-789. Anon. LITERATURA PO GEOLOGII I SMEZHNYM DISTSIPLINAM POSTUPIVSHAYA V BIBLIOTEKU OTDELENIYA GEOLOGO-GEOGRAFICHESKIKH NAUK AN SSSR ZA MAY 1958 G. [LITERATURE ON GEOLOGY AND RELATED DISCIPLINES RECEIVED BY THE LIBRARY OF THE SECTION OF GEOLOGICAL-GEOGRAPHICAL SCIENCES OF THE ACADEMY OF SCIENCE OF THE U.S.S.R. IN MAY 1958]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 129-36.

This list contains 134 references to Soviet articles published in May 1958. The references are categorized as follows: geology - 45 articles; paleontology - 37 articles; mineral deposits, methods of prospecting and research - 23 articles; hydrogeology, engineering geology - 23 articles; miscellaneous - 6 articles. Twenty-eight Soviet and 27 foreign books are listed.--LC.

1-790. Anon. LITERATURA PO GEOLOGII I SMEZHNYM DISTSIPLINAM POSTUPIVSHAYA V BIBLIOTEKU OTDELENIYA GEOLOGO-GEOGRAFICHESKIKH NAUK AN SSSR ZA IYUL 1958 G. [LITERATURE ON GEOLOGY AND RELATED DISCIPLINES RECEIVED BY THE LIBRARY OF THE SECTION OF GEOLOGICAL-GEOGRAPHICAL SCIENCES OF THE ACADEMY OF SCIENCE OF THE U.S.S.R IN JULY 1958]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 114-23.

The list contains 159 references to Soviet articles contained in Soviet periodicals in July 1958. The articles are categorized as follows: geology - 48 articles; paleontology - 18 articles; petrography, mineralogy, crystallography, geochemistry - 61 articles; mineral deposits, methods of prospecting and research - 21 articles; hydrogeology, geological engineering - 8 articles; miscellaneous - 11 articles. Fifty-nine (38 Soviet and 21 foreign) new books are listed.--LC.

1-791. Canada, Dept. of Northern Affairs and National Resources. ANNUAL REPORT, FISCAL YEAR 1957-1958: 122 p., illus., fold. map, tables, Ottawa, Queen's Printer, 1958.

Four developments highlighting the Department's activities for fiscal year 1957-1958 are: 1) the decision to establish a modern community at Frobisher Bay, Baffin Island, to serve this rapidly developing and strategically located air-transport center; 2) the winter work program in which normal construction activities and forest access roads and campground and picnic-area programs were accelerated; 3) legislation providing for federal assistance in the field of thermal electric power in 2 of the Atlantic provinces; and 4) entry into a new area of national resource development.

Other activities of the Northern Administration and Lands, National Parks, Water Resources, and Forestry branches, the National Museum of Canada, and the Canadian Government Travel Bureau are described. These include mining and mineral exploration and oil and gas developments in Northwest Territories and Yukon; paleontological field work and research by the National Museum of Canada.

Included is a special article, "Our Forests - Riches that Grow," which discusses forests in use, forest ownership, forestry problems, research and education, present industry and trade, and the outlook for the future.--G. E. Denegar.

1-792. Georgia Dept. of Mines, Mining and Geology. GEOLOGICAL INVESTIGATIONS IN GEORGIA, 1958: Georgia Mineral Newsletter, v. 11, no. 4, p. 107-109, 3 illus., Winter 1958.

Georgia's Dept. of Mines, Mining and Geology has, in 1958, carried out the following program: investigation of numerous properties, mines, and prospects; publication of technical reports and a departmental quarterly; chemical analyses of minerals, ore, and rocks; microscopic, spectrographic, and x-ray investigations; and analyses of water for industries, individuals, and municipalities. In addition, special projects undertaken were: radiation surveys, geologic mapping, mineral-resources surveys, geologic studies, and seismic investigations.

The U. S. Geological Survey, Geologic Division, has studied magnetic and gravity features of major crustal units, Fe resources, and massive sulfides. Continuing projects include investigation of Paleozoic and Mesozoic strata, a synthesis of geologic data on the Atlantic Coastal Plain and continental shelf, monazite exploration, investigation of bauxite deposits, study of monazite in granite, and study of Oligocene mollusks and gastropods and their stratigraphic significance.

The Water Resources Division of the U. S. Geological Survey has undertaken ground-water and surface-water investigations including geologic, piezometric, and topographic mapping; well-drilling programs; flow analyses; qualitative tests of water; and investigations of salt-water encroachment.--G. E. Denegar.

1-793. Johnson, H. S., Jr. GEOLOGICAL ACTIVITIES IN SOUTH CAROLINA DURING 1958: South Carolina, State Devel. Board, Div. Geology, Bull., v. 3, no. 1, p. 89-101, Jan./Feb. 1959.

During 1958 the Division of Geology of the South Carolina State Development Board concentrated on the following investigations: geology of the Irmo and Fort Jackson North quadrangles; geology and mineral resources of Edgefield, Pickens, and Union counties; limestone and marls; heavy minerals in beach sands; siliceous clay-shales of the Coastal Plain; and bauxitic kaolins. Shorter investigations included studies of monazite in Aiken County; a quartz deposit in Union County; a copper prospect in Abbeville County; metasedimentary rocks at Poor Mountain, Oconee County; Newlin bentonite deposit, Jasper County; Cooper marl near Charleston; gossan at Nanny's Mountain, York County; Meadowoods metagabbro(?), Union County; Gregory sericite deposit, Lancaster County; and bloating shale, Edgefield County.

Four reports and 12 numbers of the Bulletin of the Division of Geology were published. --G. E. Denegar.

1-794. Khamrabayev, I. Kh., and M. G. Rub. VTOROYE VSESOYUZNOYE PETROGRAFICHESKOYE SOVESHCHANIYE [ON SECOND ALL-UNION PETROGRAPHIC CONFERENCE]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 10, p. 124-28.

The conference took place in Tashkent from 19 to 23 May 1958. Over 1,000 representatives of over 100 geological organizations and societies took part. Scientists from China, Poland, East Germany, Romania, and Bulgaria also attended. The conference was opened by the president of the Academy of Science of the Uzbek S.S.R., Kh. M. Abdullayev. The Minister of Geology and Conservation of Mineral Resources of U.S.S.R., P. Ya. Antropov, reported on the extent of knowledge of the territory of the U.S.S.R., and on problems of petrology. Lectures were given at plenary sessions by Academician S.T. Dmitrov (Bulgaria), K. Smulikowski (Poland), Prof. Kautsch (E. Germany), Academician D. S. Korzhinskiy, Corresponding Members G. D. Afanasyev, Yu. A. Kuznetsov, N. A. Yeliseyev, and others. The majority of lectures and reports were concerned with the definition of laws and occurrence of magmatism in various regions of the Union, and characteristics of their metallogeny. Yu. A. Kuznetsov and Yu. M. Sheynman reported on general questions in the development of magmatism. The problem of genetic connection of endogenous mineralization with magmatism was the theme of many reports, among them a joint report by the scientific collaborators of the Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the Academy of Science, U.S.S.R., V. S. Koptev-Dvornikov, O. S. Polkvaya, M. G. Rub, I. Ye. Smorchkov, and F. K. Shipulin, and also the reports by Ye. A. Radkevich, I. G. Magakyan, and S. S. Mkrtchyan (Institute of Geology of the Academy of Science of Armenian S.S.R.) and by M. P. Materikov (VIMS). G. S. Dzotsenidze, M. A. Kashkay, Sh. A. Azizbekov, M. A. Favorskaya, and A. M. Kalik reported on the problem of the correlation of ore-bearing with extrusive formations. A. P. Lebedev and G. G. Moor reported on the magmatic formations of the plateau regions. O. A. Vorobyeva, V. K. Monich, and G. P. Bagdasaryan reported on the occurrence of alkaline magmatism in certain regions. The physico-chemical trend in the study of magmatic and post-magmatic formations was represented in reports by D. S. Korzhinskiy, V. A. Maslennikov, and I. G. Govorov. The problem of genesis, the distribution of metamorphic rocks, and their classification were the themes of reports by the Ukrainian geologists N. P. Semenenko, Ya. N. Belevtsev, and S. P. Rodionov. B. V. Zalesskiy, B. P. Belikov, and Yu. A. Rozanov reported on physical, chemical, and mechanical properties of rocks and on methods of their study. N. I. Khitarov reported on "Problems of Petrogenesis in the Light of Experimental Data," and G. D. Afanasyev reported on "Some Data on the State of the Study of the Absolute Age of Rocks and Their Geological Importance." Finally, a resolution was adopted in which the conference, after having enumerated the achievements of Soviet petrographers, complained about the shortage of laboratories for petrographers and stressed the importance of the further study of magmatic processes. --LC.

1-795. Anon. O RABOTE XI GENERALNOY ASSAMBLEI MEZHDUNARODNOGO GEODEZICHESKOGO I GEOFIZICHESKOGO SOYUZA [ON THE WORK OF THE ELEVENTH GENERAL ASSEMBLY OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS]: Akad. Nauk SSSR, Izvest., Ser. Geofizicheskaya, 1958, no. 2, p. 283-88.

A detailed report of the Eleventh I.U.G.G. General Assembly held in Toronto, Canada, Sept. 3-14, 1957. Brief abstracts are given of a number of papers read by various non-Russian participants. A few comments are included on some of the information in the papers read by some of the Western authors. --LC.

1-796. Shcherbakov, D. I. NA GEOLOGO-GEOGRAFICHESKOY SEKTSII IX SESSII TIKHOOKEANSKOGO KONGRESSA V. G. BANGKOKE [THE GEOLOGICAL-GEOGRAPHICAL SECTION OF THE IX SESSION OF THE PACIFIC SCIENCE CONGRESS IN BANGKOK]: Akad. Nauk SSSR, Izvest., Ser. Geol., 1958, no. 8, p. 109-15.

A detailed report on the work of this section during the Pacific Science Congress which took place in Bangkok (Thailand), Nov. 1957. --LC.

1-797. Langford, G. B. TEACHING THE GEOLOGICAL SCIENCES: Royal Soc. Canada, Trans., Sec. 4. Geol. Sci., 3d ser., v. 52, p. 39-43, June 1958.

Geology is a science, and teachers in this discipline must adhere to the methodology of the basic sciences. Purely descriptive subjects have their place in a curriculum. Unless they are built on observation, interpretation, and induction, they are not sciences. The manner in which outside influences affect curricula is touched upon. --Auth.

1-798. Gendron, Norman J. MOUNTING OF GEOLOGICAL SPECIMENS IN CLEAR, COLD SETTING PLASTIC: Econ. Geology, v. 54, no. 2, p. 308-10, illus., March/Apr. 1959.

Experiments on the use of Epoxy resins were carried out because present thermosetting mounting materials and equipment have been inadequate due to the time, temperature, and pressure necessary and the prohibitive costs in changing mold shapes and sizes.

Natural rubber cups brushed with a mold release are filled with 100 g. Bakelite ERL2795 Epoxy Resin mixed with 10 g. Hysol Cl hardener. These are placed before a window air conditioner set at its coldest temperature for 6 or 7 hours. For large sizes, polyethylene containers are used and less hardener is added. Identification is retained by using different colored inks.

All mounts are ready to grind and polish the day they are poured. It is possible for one man to mount 500 specimens in one day. Shrinkage is at a minimum, adhesion is generally excellent, sample is always visible, and seepage areas are avoided. --G. E. Denegar.

(A complete report of this process can be had by writing to the author, c/o General Electric Co., Schenectady, N.Y.)

1-799. Roedder, Edwin. PROBLEMS IN THE DISPOSAL OF ACID ALUMINUM NITRATE HIGH-

LEVEL RADIOACTIVE WASTE SOLUTIONS BY INJECTION INTO DEEP-LYING PERMEABLE FORMATIONS: U. S. Geol. Survey, Bull. 1088, 65 p., 6 illus., 5 tables, March 1959, approx. 200 refs.

The problems of injection and the possibility of chemical reactions occurring upon contact between earth materials and typical high-level acid aluminum nitrate wastes, from atomic reactor fuel processing, are discussed in connection with proposed methods of disposal of such wastes by injection into deep-lying, brine-saturated permeable beds (salaquifers). To discuss the mechanics of the interaction of moving waste with salaquifer minerals, the concept of a "zone of equilibration" is developed, and the factors modifying it are considered; it is shown that the width of the zone of equilibration controls the usable storage capacity of the salaquifer, per well.

Although the known variables include physical effects, chemical effects, and rate processes, most of which cannot be calculated rigorously but can be truly evaluated only by large-scale tests, it is shown experimentally that reactions with carbonates, limonite, clays, and other typical salaquifer materials will occur. These reactions can reasonably be expected to cause the precipitation of aluminum and ferric hydroxide gels, effectively blocking further injection. Whether this stoppage will occur before the amount of waste pumped into the well is sufficient to make the procedure economically feasible depends upon various factors that cannot be evaluated precisely without a number of simplifying assumptions and further experimental work, but the procedure would appear to be feasible only under certain very special conditions.

A few extrapolations of the data to other types of wastes and salaquifers are made, remedial procedures to avoid precipitation are discussed, and suggestions are offered for future studies, based on the pertinent literature.

It is concluded from safety and technical considerations that if wastes are to be disposed by injection, the only truly realistic approach to the problem involves (a) removal of the more dangerous and heat-producing long-lived isotopes, (b) aging to remove short-lived heat-producing isotopes, (c) chemical pretreatment of the waste or salaquifer or both to improve compatibility, and (d) injection into a deep-lying salaquifer of glass-sand quality that is far below any potable waters and is very carefully selected after extensive exploration and testing. The procedure might be made somewhat safer by some process whereby a portion of the salaquifer is sealed off to form a leakproof underground reservoir, but this cannot be substituted for adequate depth of burial. --Auth.

AUTHOR INDEX

Abstract

Abbott, Maxine Langford 1-667
Albee, A. L. 1-561
Amsden, Thomas W. 1-662
Andreasen, G. E. 1-556
Andreyeva, I. B. 1-642
Anon. 1-788, 1-789, 1-790, 1-795
Arabian American Oil Company Staff 1-773
Armstrong, Clarence A. 1-739
Armstrong, Frank C. 1-756
Arnold, James R. 1-695
Aronovich, Z. I. 1-680
Aronow, Saul 1-633
Asselstine, E. S. 1-787
Auger, P. E. 1-644

Baker, Bruce L. 1-768
Baranov, V. I. 1-706
Baranovskaya, N. V. 1-710
Barnes, Farrell F. 1-777
Bates, Robert L. 1-759
Bates, Thomas F. 1-751
Beikman, H. M. 1-566
Béland, R. 1-644
Bell, W. A. 1-769
Belov, I. V. 1-722
Belyakova, E. E. 1-743
Bergin, M. J. 1-757
Bergquist, Harlan R. 1-658, 1-659
Bergsten, John M. 1-771
Beroni, E. P. 1-752
Bérubé, Edgar E. 1-762
Bezsmertnaya, M. S. 1-717
Bjorklund, L. J. 1-733
Blaik, M. 1-685
Blow, Walter H. 1-665
Borovik-Romanova, T. F. 1-699
Bowyer, Ben 1-570
Brew, D. A. 1-585, 1-586
Brobst, Donald A. 1-576, 1-577
Brown, G. F. 1-626, 1-627, 1-628
Brown, Harrison 1-696
Brusilovskiy, S. A. 1-720
Buckwalter, T. V. 1-574
Bunker, C. M. 1-686
Burova, A. V. 1-684

Campbell, R. H. 1-587, 1-588, 1-589, 1-590, 1-591, 1-592
Canada, Dept. of Mines and Technical Surveys, Mines Branch 1-550
Canada, Dept. of Mines and Technical Surveys, Surveys and Mapping Branch 1-551
Canada, Dept. of Northern Affairs and National Resources 1-791
Canada, National Advisory Committee on Research in the Geological Sciences 1-785
Canney, F. C. 1-744
Carlson, Emery T. 1-763
Carswell, L. D. 1-584, 1-585, 1-586
Carter, W. D. 1-594, 1-595
Cass, J. T. 1-554
Castle, R. O. 1-564
Cate, Addison S. 1-771
Charlesworth, L. J., Jr. 1-578, 1-579, 1-581, 1-582
Chew, Ju-Nam 1-767
Clay, C. S. 1-685
Clayton, R. N. 1-707
Collins, Florence Rucker 1-659
Connally, Carl A., Jr. 1-767
Corwin, Gilbert 1-716
Criner, James H. 1-739
Curtis, Neville M., Jr. 1-635

Davidson, E. S. 1-584, 1-585, 1-586
Dean, B. G. 1-562, 1-567, 1-569, 1-624
Deasy, George F. 1-764
Dempsey, W. J. 1-556
Dibblee, Thomas W., Jr. 1-557

Abstract

Dodge, James C. I. 1-729
Dodson, C. L. 1-597, 1-598, 1-599, 1-600
Donn, William L. 1-632
Drakoulis, Sophie 1-566
Du Bois, P. M. 1-673

Eckels, Ann 1-671
Ellis, A. J. 1-694
Englund, K. J. 1-583
Ewing, Maurice 1-632

Finnell, Tommy L. 1-625
Flegontova, F. I. 1-702
Foster, Helen L. 1-716
Fox, Jeannette 1-568
Frebold, Hans 1-656
Freeman, V. L. 1-631
Friedman, Gerald M. 1-758
Frondel, Clifford 1-711
Furcron, A. S. 1-761

Galbraith, John Kenneth 1-780
Gardner, Louis S. 1-652
Gavrilova, L. K. 1-700
Gemmill, Paul 1-571
Gendron, Norman J. 1-798
Georgia, Dept. of Mines, Mining and Geology 1-792
Gerson, N. C. 1-669
Gilbert, F. P. 1-556
Gilchrist, Sybil A. 1-572, 1-573, 1-615, 1-621
Godovikov, A. A. 1-712
Goldich, Samuel S. 1-725
Gorzhevskiy, D. I. 1-717
Greiss, Phyllis R. 1-764
Groff, S. L. 1-738
Gualtieri, J. L. 1-594, 1-595

Ham, W. E. 1-662
Hamilton, John C. 1-750
Hamontre, H. C. 1-686
Harbour, R. L. 1-560
Harris, L. D. 1-607
Hass, Wilbert H. 1-666
Hawley, C. C. 1-601
Hemphill, W. R. 1-593
Henderson, J. F. 1-785
Henderson, John R., Jr. 1-556, 1-572, 1-573, 1-608, 1-609, 1-610, 1-611, 1-612, 1-613, 1-614, 1-615, 1-616, 1-617, 1-618, 1-619, 1-620, 1-621
Herz, Norman 1-565
Heyl, Allen 1-749
Hill, V. G. 1-690
Hodgson, Gordon W. 1-768
Holland, Heinrich D. 1-691
Hutta, J. J. 1-705

Ingamells, C. Oliver 1-725

Jackson, R. O. 1-627, 1-628
Jarrett, Henry 1-780
Johnson, Arthur 1-787
Johnson, Henry S., Jr. 1-793
Johnson, R. B. 1-560
Johnstone, M. H. 1-774
Jordan, Louise 1-770

Kalenov, A. D. 1-701
Kalita, E. D. 1-699
Karapetyan, N. K. 1-681
Katchenkov, S. M. 1-702
Kaufmann, Godfrey F. 1-772
Keller, B. M. 1-651
Kennedy, N. C. 1-596
Kennedy, Richard A. 1-740
Khamrabayev, I. Kh. 1-794
Kleinhampl, F. J. 1-753
Klepper, M. R. 1-631
Knopoff, Leon 1-675

Abstract

Knowles, Doyle B. 1-740
Kogan, R. M. 1-687
Kolb, Charles R. 1-779
Komarov, P. V. 1-713
Kossovskaya, A. G. 1-654
Kouvo, Olavi 1-708
Krylov, I. N. 1-651
Kudryakova, V. A. 1-712
Kudryashova, V. I. 1-714
Kuenen, Ph. H. 1-723
Kurshakova, L. D. 1-719
Kuzmina, L. A. 1-706

Landis, E. R. 1-754
Langbein, W. B. 1-731
Langford, G. B. 1-797
Langston, Wann, Jr. 1-663
Leopold, L. B. 1-728
Lewis, R. Q., Sr. 1-587, 1-588, 1-589, 1-590, 1-591, 1-592
Litvina, L. A. 1-709, 1-710
Livingstone, D. A. 1-632
Longwell, C. R. 1-570
Lovering, T. G. 1-752
Luttrell, Gwendolyn W. 1-742
Lytle, William S. 1-771

McGill, J. T. 1-558
McGowan, E. F. 1-608, 1-609, 1-610, 1-611, 1-612, 1-613, 1-614, 1-616, 1-617, 1-618, 1-619, 1-620
McKeown, F. A. 1-601
McQueen, Kathleen 1-604, 1-605, 1-606
Madden, Theodore R. 1-674
Maher, T. P. 1-775
Malinovskaya, L. N. 1-683
Marakushev, A. A. 1-721
Marshall, Donald J. 1-674
Mason, Brian 1-689
Maxwell, C. H. 1-561
Meidav, Tsvi 1-778
Miller, Don J. 1-677
Miller, E. Willard 1-765
Miller, G. A. 1-584
Miller, R. L. 1-607
Moore, David G. 1-726
Muraveva, A. N. 1-703
Myers, Alfred T. 1-750

Negrey, Ye. V. 1-651
Nelson, Samuel J. 1-653
Newcomb, L. E. 1-737
Nikiforoff, C. C. 1-636
Norris, D. K. 1-776
Norris, S. E. 1-641
Northrop, J. 1-685

Odishaw, Hugh 1-670
Ogurtsov, K. I. 1-684
O'Keefe, J. A. 1-671
Oliver, Jack E. 1-676
Olshanskiy, Ya. I. 1-693, 1-720
O'Neil, Robert L. 1-751
Oppenheim, Victor 1-782
Orkild, P. O. 1-601
Osipova, A. I. 1-660
Osterwald, F. W. 1-562, 1-567, 1-569, 1-624
Owen, Vaux, Jr. 1-736

Pampeyan, E. H. 1-570
Park, C. F., Jr. 1-571
Parrish, I. S. 1-625
Pavlovskiy, Ye. V. 1-650
Pearre, Nancy 1-749
Perry, Eugene C., Jr. 1-761
Peters, B. 1-688
Petersen, Richard G. 1-750
Peterson, W. C. 1-732
Péwé, T. L. 1-555
Pichler, Ernesto 1-715
Pierson, C. T. 1-753
Playford, P. E. 1-774
Pollock, D. W. 1-746

Abstract

Pomeroy, J. S. 1-603
Powell, John Wesley 1-783
Prichard, G. E. 1-568
Pride, R. W. 1-734

Quebec (Province), Dept. of Mines 1-762

Rabinovich, A. V. 1-703
Radbruch, D. H. 1-559
Rainwater, F. H. 1-733
Rand, John R. 1-786
Rau, W. W. 1-622
Ray, R. G. 1-605
Reed, E. C. 1-568
Resources for the Future, Inc. 1-780
Rickaby, H. C. 1-781
Ridge, John D. 1-741
Riley, G. C. 1-553
Robertson, J. F. 1-623
Robinson, Florence M. 1-658
Roedder, Edwin 1-799
Rogers, Allen S. 1-730
Rosenblum, Samuel 1-756
Rosholt, John N., Jr. 1-692
Rossman, Darwin L. 1-748
Rub, M. G. 1-794
Ruppel, E. T. 1-631
Russell, Loris S. 1-664
Ruttenberg, Stanley 1-670

Schanz, John J., Jr. 1-766
Scharon, LeRoy 1-778
Schlocker, Julius 1-559
Schnabel, R. W. 1-578, 1-579, 1-580, 1-581, 1-582
Schwartz, George M. 1-747
Shafiro, Ya. Sh. 1-646
Shcherbakov, D. I. 1-796
Sheridan, D. M. 1-561
Shoemaker, E. M. 1-594
Shulhof, W. P. 1-705
Shumway, George 1-726
Sigafoos, Robert S. 1-639
Simpson, H. E. 1-563
Slepnev, Yu. S. 1-704
Small, Walter M. 1-645
Smirnov, A. M. 1-647
Smith, C. M. 1-705
Smith, Ollie, Jr. 1-784
Snyder, G. L. 1-630
Sokol, Daniel 1-777
Sokolov, G. A. 1-713
Soren, Julian 1-575
Sorensen, Harry O. 1-763
Spicer, H. C. 1-641
Squires, R. K. 1-671
Stalker, A. MacS. 1-552
Starik, I. E. 1-709
Stelck, C. R. 1-657
Stephens, James G. 1-757
Stewart, J. W. 1-678, 1-679
Stone, Albert W. 1-738
Strahl, Erwin O. 1-751
Stugard, Frederick, Jr. 1-760
Svoboda, R. F. 1-568

Taylor, F. C. 1-629
Thaemlitz, Doris 1-725
Thames, John L. 1-637
Theobald, P. K., Jr. 1-745
Thompson, C. E. 1-745
Thompson, George A. 1-672
Thornton, Charles P. 1-698
Tikhomirov, V. V. 1-718
Tocher, Don 1-677
Trexler, J. Peter 1-575
Tschanz, C. M. 1-571
Tuchkov, I. I. 1-655
Turanskaya, R. V. 1-700
Tyson, Natalie S. 1-572, 1-573, 1-608, 1-609, 1-610, 1-611, 1-612, 1-613, 1-614, 1-615, 1-616, 1-617, 1-618, 1-619, 1-620, 1-621

Abstract
Udintsev, G. B. 1-642
Uhley, Robert 1-778
U.S.Waterways Experiment Station, Vicksburg,
  Miss. 1-779
Urey, H. C. 1-697

Vaasjoki, O. 1-708
Van Horn, Richard 1-561
Van Lopik, J. R. 1-779
van't Woudt, Bessel D. 1-638
Vasilyeva, Z. V. 1-714
Vongaz, L. B. 1-648
Vvedenskaya, N. A. 1-682

Wagner, W. R. 1-727,1-771
Wait, Robert L. 1-735
Warren, P. S. 1-657
Weeks, Lewis G. 1-643
Weeks, W. F. 1-753
Weir, G. W. 1-596,1-597,1-598,1-599,1-600
Weis, Paul L. 1-756

Abstract
Weld, B. A. 1-787
Weller, J. Marvin 1-724
White, Eugene Wilbert 1-755
White, W. Arthur 1-715
White, William A. 1-640
Wilson, L. R. 1-668
Witkind, I. J. 1-602
Wolman, M. Gordon 1-634
Wood, G. H., Jr. 1-560,1-575
Wright, H. D. 1-705

Yates, R. G. 1-623
Yelenosky, Andy 1-575
Yershova, Z. P. 1-693

Zaklinskaya, Ye. D. 1-661
Zhdanova, M. V. 1-703
Zhirmunskiy, A. M. 1-649
Zhirov, K. K. 1-710